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JOURNAL OF MAMMALOGY

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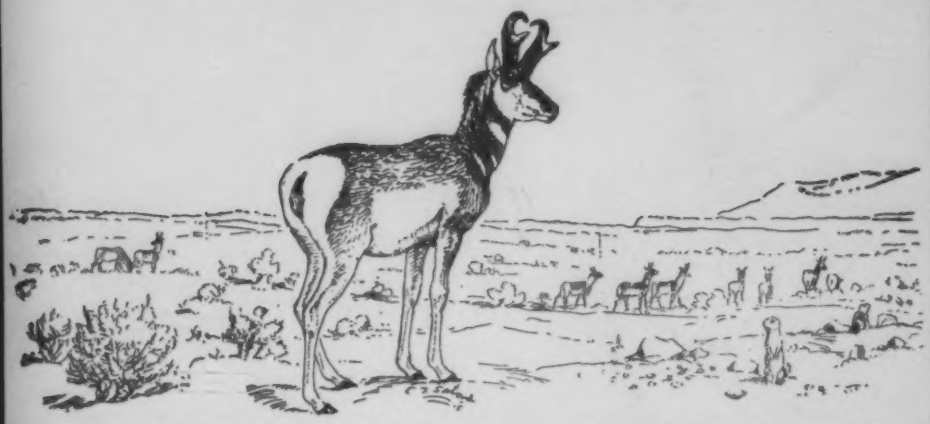

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MICROTUS CALIFORNICUS IN CAPTIVITY

BY RAYMOND M. SELLE

The outbreak of rodents in the Buena Vista Lake region of Kern County, California, during November, 1926, to February, 1927, has been described by Hall (1) and also by Humphrey (2). Hall estimated the number of mice including both the meadow mouse (*Microtus californicus*) and the house mouse (*Mus musculus*) to have been more than eighty-two thousand (82,280) per acre. In the later part of January, 1927, after there had been at least three well defined migrations from the dry lake bed, there yet remained in the more densely populated areas where green food was most abundant as many as four hundred occupied burrows, each of which harbored on the average ten *Microtus californicus*, making a total of four thousand meadow mice to the acre. These figures were obtained from Stanley E. Piper and Dr. Walter P. Taylor, both of the U. S. Biological Survey.

Practically no data have been published on the subject of *Microtus californicus* in captivity. Bailey (3) has described many of the habits of an eastern meadow mouse (*Microtus pennsylvanicus*) which he kept successfully in captivity for several years.

During the outbreak of rodents in the Buena Vista Lake area the writer made a trip to the infested region and collected more than two hundred live *Microtus californicus*. Although it was possible to catch the mice in broad daylight while they were running over the ground from one burrow to another, we found that it was much easier to uncover the shallow burrows with a stick or a shovel and pull out the rodents that had taken refuge in them.

The burrows were about one and one-half inches in diameter and

seldom extended more than ten or twelve inches below the surface of the ground. They were not very extensive and many of them were less than three feet in length. In some cases the animals had followed wide and deep cracks in the heavy dry soil of the lake bottom. When the burrows were uncovered a varying number of *Microtus californicus* and occasionally other rodents were found. The following figures refer to the number of *M. californicus* that were caught in the different burrows: 9, 2, 3, 3, 4, 4, 7, 3, 6, 6, 10, 8, 2, 19, 4, 9, 8, 5, 2, 2, 10. In addition to these, three other burrows contained as follows, 5 *Microti* and 3 *Mus musculus*, 24 *Microti* and 2 *Mus musculus*, and 1 *Microtus* and 1 male kangaroo rat (*Dipodomys*). This same kangaroo rat lived peaceably with an adult male *Microtus* in captivity for three months until it was killed for histological material. In each of the four cases where two meadow mice were found alone, the two consisted of an adult male and an adult female. Several of the burrows yielded a pair of adults and a number of young about two-thirds grown.

No very young *Microti* were found (that is, none less than half-grown). Judging from the average size of the young that were caught and the length of the period of gestation (about 21 days), breeding must have ceased about the last of October or the first part of November. The last young were born about the time that the house mice were beginning to migrate from the lake bed in great numbers.

Some of the larger females showed external signs of oestrous cycles, although we caught only one pregnant female in the area where we collected. In this case there were five embryos less than two millimeters in length.

Of the two hundred live meadow mice that were brought to Los Angeles only seven females and one male are alive at the present time (August 1, 1927). Thirty-three of the males were killed, weighed and preserved for future study. These males were a fair sample of the entire lot of males that were caught. They varied in weight between 38 and 87 grams, and averaged 62.2 grams. More than a hundred died during the first month of captivity. Most of them showed symptoms of an infection which caused them to snuffle and their eyes to secrete a yellowish serous fluid.

A colony averaging between twenty and thirty has been maintained since February, 1927. The *Microti* have been kept in small individual cages within a small screen room built in half of a double garage.

The cages were made by folding a piece of wire screen (quarter-inch mesh hardware cloth) 8 inches wide by 46 inches long, into a rectangle

9½ inches by 13 inches. This formed the sides of the cages. One black rectangular shaped baking pan, 2½ inches deep and 9½ inches by 13 inches (bottom measurement), was used for the top and another for the bottom of the cage. It was not necessary to fasten down the top pan, which served as a door and a cover. These cages were satisfactory, comparatively inexpensive, easily made and easily cleaned. About an inch of dry soil and a handful of straw were kept in the bottom pans of the cages.

The diet that proved satisfactory was a mush, which was recommended by Dr. F. B. Sumner, and to which was added sodium chloride and calcium carbonate according to Cooley and Slonaker (4). The mush was made as follows:

Four parts by volume of alfalfa meal and 1 part of wheat germ (farina) were thoroughly mixed in large quantities and kept on hand. The following ingredients and proportions were used:

Dry alfalfa and wheat germ mixture	290 grams
Milk (whole pasteurized)	16 fluid ounces
Sodium chloride	2 grams
Calcium carbonate	3 grams
Cod-liver oil (Eli Lilly Company)	1 tablespoonful

The sodium chloride and the calcium carbonate were dissolved in the milk which was thoroughly mixed with the cod-liver oil and then poured over the dry mixture and stirred. The mixture should be a mush of uniform consistency, moist but not "sloppy."

The above quantity was more than enough for twenty-five *Microti*. No records were kept as to the amount of food they ate, although it varied considerably from day to day. The mush was occasionally supplemented with small quantities of lawn clippings, grass, rolled barley, or wheat.

The zinc tops of Mason jars, after the opaque glass had been removed, were used as dishes to hold the mush. They were easily cleaned, inexpensive, and did not rust nor break.

Small metal pans, ¾ inch deep and 1¼ inches in diameter, were used as water dishes. These were obtained by cutting them out of small biscuit or muffin pans. Several strands of wire were cut in the screen at one end of the cage so that the pan could be wedged into the hole and held in place between the screen and the bottom pan of the cage. This permitted the pans to be removed, cleaned and filled without opening the cage.

From January to May no water was given to the mice except that which they got by eating spineless cactus, which they ate in considerable quantities. This method has been followed by Dr. F. B. Sumner who has kept white-footed mice (*Peromyscus*) in captivity for a number of years. From May on, however, water was made available and, although cactus was kept in the cages, very little cactus was eaten by the mice when they had access to water and the mush.

There was considerable difference in the dispositions of different individuals. A few were very docile; the majority would attempt to bite the fingers, if caught and picked up. It was found advisable to wear a pair of leather driving gloves to protect the hands from the severe wounds that they could inflict with their sharp incisor teeth. Some of the individuals were very inquisitive and would come to the front of the cage when anyone approached, others would scurry for their straw-thatched nests. They were generally very tidy and

TABLE 1

MOTHER	BORN	NUMBER OF YOUNG	FEMALES	MALES
20	March 3	4	2	2
2	April 17	5	2	3
10	May 19	5	1	4
9	June 17	5	2	3
1	August 1	5	?	?

cleanly and usually deposited their small fecal pellets in one corner of the cage. Some individuals, however, regularly deposited their feces in the dish containing the mush.

The litters indicated in table 1 were born in captivity.

The litter born August 1 was the first litter of the second generation in captivity. The mother was born on April 17 and the male was born March 3. At the time of writing the young were only one day old and the sexes could not be determined. Of the nineteen young in the first four litters, seven were females and twelve were males.

The period of gestation was very close to twenty-one days (21, 20 days and 12 hours, 22, and 21 days), which is the same as Bailey found in *M. pennsylvanicus*.

The young were hairless and their eyes were closed when born. Their eyes usually opened on the ninth day although some did not open their eyes completely until the tenth. The young of one litter,

born June 17, averaged 2.7 grams and those from the litter born August 1 averaged 3.66 grams at birth.

Bailey states that the young of *M. pennsylvanicus* were weaned when about twelve days old, but the young of *M. californicus* born June 17 were still nursing on July 10, when they were twenty-three days old and averaged 27.1 grams in weight. They had, however, been eating some of the grass and mush for about two weeks. Slonaker and Robertson (5) state in regard to their white rats that the young at the age of twenty days, when they were usually weaned, weighed between 30 and 45 grams.

Table 2 shows the gain in weight of the litter of five born June 17. They were weighed every day, but the table shows the weights at intervals of five days. Average gain 1.12 grams per day for thirty days.

TABLE 2

DATE	AGE	AVERAGE WEIGHT
	days	*grams*
June 17	Born	2.70
June 22	5	5.44
June 27	10	8.30
July 2	15	13.10
July 7	20	21.00
July 12	25	30.00
July 17	30	36.06

The actual weight of the five at thirty days of age, was as follows:

	grams		*grams*
♂ 1	36.00	♀ 16	32.90
♂ 2	40.70	♀ 17	34.40
♂ 3	41.90		

On August 1 when they were forty-five days old they weighed 46.0, 60.0, 61.2, 35.5, 47.1 grams, respectively. Their average weight was 50.06 grams. During the last fifteen-day period (thirtieth to forty-fifth day) the average daily gain dropped from 1.12 to 0.93 gram per day.

Table 3 shows the weights for three other litters and for seven adults that were caught in the region of Buena Vista Lake in January and kept in captivity. These data show that *M. californicus* makes most of its growth during the first two months after which the rate of growth is slower.

The object of this research was to determine whether or not *Microtus californicus* could be kept successfully in captivity. These results show that they can be and that their rate of reproduction in captivity is more than enough to maintain a colony.

TABLE 3

ANIMAL AND SEX	BORN	WEIGHED ON	WEIGHT
			grams
♀ 12	March 3	August 1	60.0
♀ 13	March 3	August 1	54.0
♂ 90	March 3	August 1	62.2
♀ 1	April 17	August 1	54.5
♀ 15	April 17	August 1	55.5
♂ 12	April 17	August 1	65.7
♀ 19	May 19	July 26	50.5
♂ 4	May 19	July 26	65.7
♂ 5	May 19	July 26	75.5
♂ 6	May 19	July 26	61.8
♂ 7	May 19	July 26	70.3
♀ 3	Caught (adult)	August 1	70.0
♀ 6	Caught (adult)	August 1	70.7
♀ 7	Caught (adult)	August 1	46.1
♀ 9	Caught (adult)	August 1	59.5
♀ 10	Caught (adult)	August 1	69.7
♂ 60	Caught (adult)	August 1	93.0
♂ 69	Caught (adult)	August 1	99.5

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THE BEAVER IN NORWAY

By Sigvald Salvesen

[*Plate 10*]

In earlier times the beaver inhabited a large area in both the old and the new world. In Europe they occurred in all countries except Ireland, and in Asia they reached the Euphrates River. As the land became cultivated beavers were nearly extirpated. No one cared for them, and they were not considered as game that ought to be protected. The German zoologists Carl Vogt and Friedrich Specht in their work "Die Säugetiere," published in Norwegian translation in 1886 by Alb. Cammermeyer, Oslo, say about the beaver: "Except such single rivers, where fanciers of these animals have given a sanctuary to some small colonies, the beaver is *fortunately* quite eradicated all over cultivated Europe. No doubt some authors have set up sentimental lamentations over its extermination. However, it must be admitted that the beaver is one of the most harmful animals to the woods, and we need indeed wood materials more than beaver skins and castoreum!" There are still many people in Norway who say the same, but fortunately the opinion as a rule has altered in favor of the beaver. Now there is no danger of its extermination, at any rate in Norway.

There are, however, not many places in Europe where beavers now occur. At the mouth of the Rhone River in southern France there are some colonies, and about two hundred animals inhabit the River Elbe in Germany. Some beavers lived before the great war in the Pripet River, which runs through the marshy woodland called Polesje, now belonging to Soviet Republic Ukrainia. All precautions are taken to protect the Elbe beavers. The marshes along the Elbe are flooded during the spring season, and great hillocks with artificial beaver lodges on top have been constructed, so that the beavers may have a retreat. They have often been seen to use these emergency lodges.

The greatest colonies, however, are found in southern Norway, particularly along the River Nidelven. They have increased rapidly the last few years and one estimates there are now about 12,000 of them. In 1883 only about one hundred animals were left, so it is a very fine increase. In earlier times they inhabited nearly all the country up to the Arctic Ocean, where they were once abundant in the many rivers and lakes. By the Laps, the original inhabitants of these districts (Mongolian race), the beaver was called "Maja," and even now a great

lake bears the name Maiavatn (Maialake) in Trondelagen, north of Trondhjem. Seventy or eighty years ago the last beaver was killed in north Norway. Later the remaining colonies in this country were in Aamli. Now they are to be found in the districts Rogaland, Vest-Agder, Telemark and Aust-Agder. In Norwegian the beaver is called "bever," a Danish expression. By the inhabitants of the above-named districts it is called "bjor." In all names of lakes, farms, and dams combined with beaver, and which names are hundreds of years old, only "bjor" is used, as, Bjorvatn (Beaverlake), Bjorstem (Beaverdam), Bjorhyl (Beaverpond). Beavers are steadily spreading to new areas in Norway.

Until 1918 no open season was allowed on beavers but now they have become so numerous that they do much harm to private property. The land owners up to 1918 were granted a replacement for the damage. The amount had to be fixed by an official forest inspector, and paid by the state. However, so many complaints over damages came in and there were so many applications for replacement that the forest inspectors spent much of their time in fixing indemnities. It was also too expensive for the state. It was clear that a change had to be made. Therefore, an open season of fourteen days was allowed in 1918, and no claims could be made for damages done by beavers. Beavers could only be hunted with guns, and no traps or pitfalls used. However, in so short time, and thanks to the difficulty of shooting beavers, only a few land owners got rid of the animals. In 1916, therefore, a three months open season from October 1 to January 1 was fixed, and traps and pitfalls were allowed. This is not the best time to get prime fur, but later in the winter it would be difficult to catch beavers as the lakes and streams are then frozen, and no damage is allowed to be done to the beaver lodges. Several hundred beavers were killed last season. It is only in districts where beavers are numerous that open seasons are allowed on them.

The deciduous trees in Norway on the bark and twigs of which the beaver feeds are aspen, birch, oak and alder. This kind of wood is used as fuel by the farmers and in some towns. During the world war, when coal became scarce because of the terrific German submarine war in the North Sea, much of the deciduous wood was removed for fuel on railways and steamers. This was not good for the beavers as their food was taken. Fortunately now new trees are coming back.

I have often noticed that beavers inhabit a lodge only two or three years. Then they move to a better feeding place. Along a stream one

may therefore find both new and abandoned dams. Now and then, beavers make excursions up and down a stream and for a day or more inhabit an abandoned lodge. When new trees have grown up around the pond or lake, the lodge and dam as a rule are repaired and used again.

The Norwegian beaver lives in just the same manner as the Canadian species. However, I have never observed that it builds lodges on small rocks or islands in the lake or pond. I have seen dams up to 150 feet long and 7 or 8 feet high. Lodges may be up to 20 or 30 feet long. If there is flat, marshy land around the lake, the lodge is made like a mighty dome. There may be beavers of the last two or three years' litters in one house, and once five beavers were caught in one lodge. In spring, when the young are rambling far, they sometimes make small mudheaps, close to, or in the water,—probably a kind of communication to other beavers.

Beavers sometimes build sluices to float their food to the pond. I have a good description of this from forest inspector Stoltenberg in Fyresdal. He went out on a midsummer evening to look at beavers and about 12 o'clock they came out. A little stream ran through a thicket of small aspen trees and in this stream the beavers had built many small dams. On top of a slope was a beaver that rolled down trunks cut in suitable lengths. Beneath the slope was another beaver that rolled the trunks to the stream, where still another floated them to the first dam. This last beaver rolled the trunks over the top of the dam and others took them further down from dam to dam.

In October the beaver fells many trees, cuts them up in suitable lengths, and places them in front of the lodge for winter food. Beavers come out of their houses in winter and I have often seen their tracks in the snow. They make a hole in the ice close to the shore where they come out of the water. They cut trees also in the cold season, but on very cold days and during snowstorms they keep in their huts.

Some beavers live in tunnels dug in the banks. The first time on new places they live in such holes, and often in summer time, as it is then too warm in the hut. Perhaps many such "bank beavers" are old bachelors.

Beaver huts are very solid. I have during many years observed a hut in the Nidelven which is flooded spring and fall, and logs drift against it, but it is still quite in order.

Beavers have been introduced in northern Norway, and have built houses and seem to thrive there. Some have also been sent to Sweden, where the last beavers were killed about 1870.

The weight of the Norwegian beaver when full-sized runs about 20 to 30 kilos. The largest I have heard about weighed 28 kilos, but they are not commonly so heavy. The fur is thinner and lighter than that of the Canadian beaver, but I have seen skins nearly black. Of course, the fur would be better if taken in January or February.

The beaver in Norway has few enemies except man. Bears, wolves, lynxes and eagles in earlier times were bad trailers of them, but these animals are now practically extinct. A few winters ago a man at Sigridnes in Aamli found the remains of two beavers that had been killed and eaten by two lynxes, the trails of which could be seen in the snow.

When beavers are left alone and undisturbed, they will become quite tame. In Nissedal at Lake Nisservatn belonging to Nidelven, a pair of beavers had built their lodge near a farm. Deciduous trees were scarce in the neighborhood and the beavers therefore broke through the orchard fence and cut down several small apple trees, dragged the trunks to the water, and floated them to the lodge. One night as the farmer came out to look after the orchard, a beaver came dragging four or five small aspen trees about 1½ inches thick and 10 to 12 feet long through the farmyard, holding the trunks between its fore legs. When the beaver observed the man it left the load and made for the water. The aspen trees had been cut just above the farm. Some of the apple trees cut were only 6 feet from the farm house.

As this farm lay in a district with no open season for beaver, I received a license to kill the beavers, and send them to the Museum of Natural History, Helsingfors, Finland. I set up a shelter of spruce branches near the beaver lodge and one cold night in November, when the moon was full, placed myself behind the shelter. It was not long till I saw moving ripples on the water. The beavers were reconnoitering before approaching the banks. A little later a beaver came up on the bank just in front of my shelter and only a few yards away. It sat there a short time gnawing some branches, and then plunged into the water. I saw it swim across the pond where I had placed an aspen trunk as a bait. It began immediately to cut. I sat a moment and looked at the busy little "lumber jack" at work, and then I fired the shot. The little dambuilder sank back into the water and lay floating motionless. I went around the pond and lifted the animal up. It was only a small cub weighing 5 kilos. I waited for an hour and then again saw ripples on the water, but the beavers landed farther up the pond, where I heard them cutting on some big alders. I went along the bank, and then one of the beavers made a mighty splash with its tail and I did not see them again that night.

FIG. 1. Typical lake with many beavers, Aamli, Norway. FIG. 2. Norwegian beaver. FIG. 3. Beaver pond in Hansesdal, Simonstad, Norway. FIG. 4. Beaver lodge after dam has been broken, Svaanevatn, Fyresdal, Norway. Note the two entrances.

I have experienced that the beaver may attack man when frightened. Some years ago my brother, a pharmacist at Stavanger, and I had been out fishing. When returning we tied the boat in a creek near a beaver lodge. From the creek there led a beaver trail to a small lake a hundred yards away. We followed the trail a little distance up a hill, and just at the crest we caught sight of a large beaver coming straight toward us in the trail among the bushes. We made preparations to take a photograph. However, when I stepped aside to get a better position, the animal made a rush out of the trail to reach a small stream on the left. I met it and then it again came into the trail and with good speed sprang straight against my brother who stood in the middle of the trail. When the beaver reached him it cut at him with its long chisel-shaped teeth, so that my brother had to jump high in the air in order to avoid a severe bite. I could hear the loud snap of the beaver's teeth. The beaver jumped into the water and we saw it swim like a brown shadow under the water to the lodge.

In Oeiestad near Arendal I heard about a man who was attacked by a beaver. As he and some others were walking along a road through a wood, suddenly a beaver jumped out of the underbrush and bit such a severe wound in the leg of the man that he had to lie in bed for several days.

Some years ago a man in Aamli was out with his dog in the forest. As they were walking along a lake they caught sight of a beaver cutting a tree about fifty yards from the water. When the beaver saw them it made for the water and the dog sprang after it. The beaver at first made no attempt to defend itself. However, when they were close to the water the beaver seized the dog by the fore paw with its teeth. Out into the water went both of them. The beaver dragged its antagonist under the surface and the man thought that he would never see the dog again. After a little time, however, the dog came to the surface panting and snorting, and nearly drowned, but otherwise all right. The dog did not hunt beaver again!

In the years 1922 to 1924 I caught ten beavers alive and sent them to zoological gardens. Most of these I caught in barrels placed in pitfalls dug in trails. This method is, however, quite uncertain, especially in spring and early summer when the young beavers ramble far. A trapper who had been trapping in Canada caught a beaver for me in a curious manner. He observed the animal in a small stream in full daylight. He jumped at the animal, caught it by the tail, lifted it up so it could not bite, and put it in his big knapsack. The beaver at first

made strenuous efforts to get out, but finally lay still, and the trapper carried it safely to his farm. Another manner used in olden time was to drive some arm-thick sticks through the ceiling of the beaver lodge so that the entrance was blocked. Then the walls were broken in and the animals killed. This method was especially used in the winter when the lakes and ponds were frozen. Now it is prohibited to disturb or destroy beaver lodges.

I found that the captured beavers as a rule became quite tame in a short time and would take their food from my hand. However, some were shyer. They were shipped in cases covered with iron plates and 3 x 3 x 2 feet in dimensions, with wire above for light and air. A water-tank 3 x 1½ feet was placed in the case and a large sack of birch and aspen twigs was sent with the shipment. The officials were instructed to feed the animals twice a day and fill the tank with fresh water several times each day. Several of the animals died some days or weeks after they reached their destination, most of them from diseases of the intestines. Some of them were thin, as it was in early spring. It would undoubtedly have paid to have had caretakers accompany the animals in transit.

Aamli, Norway.

OBSERVATIONS ON NOCTILIO

By George G. Goodwin

During a visit to Botany Bay, St. Thomas, American Virgin Islands, in May, 1926, I made some interesting notes on the habits of *Noctilio leporinus mastivus*. My observations of the food consumed by this bat indicated, for the greater part, an insect diet, which I later confirmed by an examination of the stomach contents of specimens collected.

Acknowledgment is due to Charles C. Sperry, United States Biological Survey, for assistance in identification of insect and fish remains and also to the United States National Museum for the loan of additional specimens.

Noctilio, as far as I am aware, has been generally accepted as a fish-eating bat, and publications, hitherto, have favored this belief. I present this information, therefore, in the hope that it will add something to our knowledge of the life-history of this bat.

Botany Bay is located at the extreme western end of the island of

St. Thomas and can be reached by horseback. There is a good automobile road from St. Thomas as far as Brewers Bay, which is about half-way. The road then ascends a steep mountain range, and after passing a few settlements of one or two houses, finally comes to Botany Bay. The island at this point is about three-quarters of a mile wide, and the vegetation is very dense and composed chiefly of low trees, bushes, and trailing vines. There are a few large trees and a small grove of coconut palms at the foot of a rocky mountain ridge that rises abruptly about two hundred yards from the bay.

The prospect of collecting bats here was not very promising; caves suitable for bat roosts could not be located and the country was too much enclosed to offer more than a chance shot at them. I found *Noctilio* to be a frequent visitor at a small, fresh-water pool at the side of the trail. This water hole was artificial but contained small minnows, and was the only pool in a radius of about three miles. It was about three feet deep in the middle and twenty feet in diameter. One side of it was lined with trees and thick bushes; the other was open to a low plain covered with a luxuriant growth of tropical vegetation teeming with insect life.

Visiting this pond after dark on May 13 in search of frogs and salamanders, I was surprised to hear several loud splashes coming from the middle of the pool. The disturbance was made by three large bats which were flying back and forth over the plain, making a swoop down as they crossed the water. The night was too dark to see what species they were, but the musky odor in the air identified them as *Noctilio*.

Two specimens of this bat were soon secured by knocking them down with a stiff switch. The process was very simple. I posted myself at the edge of the water in the course that the bats seemed to take; one flew swiftly overhead, checked its speed, turned and struck the water as it came toward me. A bright flashlight switched on seemed to confuse the bat for a second; it hesitated and was brought down with a quick blow from the switch. Falling into the water, it swam to the other side. Though injured it could swim with considerable ease, using both wings under the water as oars. Several other specimens that I knocked down tried to get away by crossing the water and hiding in the bushes on the other side; some swam three or four times around the pond in a vain attempt to escape. They soon drowned, however, when held under water a few minutes. One would-be specimen that I hit hard across the back fell with a splash into the water, swam half-way across the pond,

rose from deep water and flew away. Others that I hit, but not hard enough to break any bones, kept on flying. *Noctilio*[1] seems to be a strong swimmer and, unlike other bats that I have seen in the water, swims with only its head above the surface.

I noted that the musky odor of *Noctilio* taken at Botany Bay, though strong, was not objectionable, although a specimen taken at Vega Baja, Porto Rico, in February, had a very offensive smell which seemed to cling to my hands for days.

Noctilio was usually seen a little while after sunset flying two or three together about ten feet from the ground. They were easily distinguished from the fruit bats by their larger size and steadier flight. The first arrivals in the evening flew at considerable speed,[2] as if coming from a distance, and reminded me more of swallows than of bats. They visited the water regularly at intervals of about twenty minutes. Upon arriving at the pond they made two or three successive splashes and appeared to be drinking rather than fishing. They always hit the surface of the pond near the middle where the water was deep, whereas the fish, of which there were plenty, were always seen in shallow water near the sides. Sometimes as they passed me on their way to the pond they made a sharp, crunching sound, as if grinding the horny parts of a large beetle between their teeth. This noise was made only as they approached the water and never as they left.

A close-up view of one of these bats striking the water revealed that, at this pond at least, it was not fishing. Neither fish nor insect could be seen near the surface of the water before the bat struck, and a specimen which was immediately knocked down, did not have any trace of food in its mouth. The action was too rapid to see exactly what happened. The interfemoral membrane seemed to be used to scoop up the water, and the head was thrust forward either in search of food or to drink.

An examination of the stomach contents of five specimens of *Noctilio* taken at Botany Bay, St. Thomas, in May, 1926, showed the remains of insects exclusively. Two of the bats, taken early in the evening, had consumed a great many ants. Three other specimens taken later in the evening were gorged with fragments of many scarabaeid beetles and a

[1] *Artibeus* that I knocked down into the water did not make any attempt to swim and soon drowned.

[2] At Vieques two *Noctilio* flew along in front of the head lights of a car in which I was riding. They kept in front of us for a quarter of a mile, going at twenty miles an hour, but swerved to one side when the speed was increased.

few other insects; their stomachs were packed tight with food. The stomach contents of two specimens of *Noctilio* taken by H. E. Anthony at Old Loiza, Porto Rico, in July, 1916, also revealed the remains of insects exclusively. These specimens, however, were taken in the day time and had digested most of their food. Six other specimens collected by Mr. Anthony at the same time and preserved in alcohol had their stomachs empty. One specimen of *Noctilio* from Surinam, collected by C. J. Hering, had consumed a great many ants, a few beetles, and had a quantity of Lepidoptera scales in its stomach. One hundred per cent fish remains, however, showed in the analysis of the stomach contents of one specimen of *Noctilio* from Trinidad. The most noticeable evidence of these fish remains was the many minute particles of silvery white argenteum of fishes that glittered in the light. The stomach also contained recognizable fragments of fish scales, apparently of an anchovie. Two other specimens, one from Trinidad and one from Surinam, had slight traces of fish remains, but not worthy of further comment.

Von Tschudi (Fauna Peruana, p. 76, 1844), writing of the habits of *Noctilio* as observed in Peru, remarked that it lived in hollow trees and "feeds upon beetles, which we always found in their stomachs." Its insectivorous habits have also been noted in Brazil by Prince Maximilian Weid of Neuied (Beitr. Naturg. Brasil, p. 223, 1826), and in Jamaica by P. H. Gosse who, having procured some living specimens from a cotton tree, found that they fed on cockroaches. Gosse says: "I presented to one a large cockroach, which he seized greedily and munched up, moving the jaws vertically. The eating was attended with a loud and very harsh cranching of the teeth—not produced by crushing the horny parts of the insect, for it was equally perceptible when munching a bit of soft flesh. The jaws moved rapidly, but yet the mastication was a long operation, for it appeared to be performed almost wholly by the canines. As the insect was progressively masticated, portions were allowed to fall into the cheek pouches (the one being pretty well filled before the other was used), which when full hung down on each side of the lower jaw to the depth of three or four lines, like distended bags, displaying a warted surface. When the whole of one cockroach had been masticated, and deposited in the cheek pouches, it would take another, which was gradually disposed of in the same receptacles; then, after a few moments' intermission, by a contortion of the jaw, aided by the motion of the muscles of the pouch, a portion was returned to the mouth and again masticated. This was repeated

till all was swallowed and the pouches appeared empty and contracted out of sight. The whole process was much like rumination. Small portions of the muscle of a bird, which were presented to one, he chewed up and deposited in the pouches; but after being regurgitated, and a second time masticated, they were expelled instead of being swallowed. The process of eating seemed an awkward one; it was a rapid succession of choppings with the long canines, through which the tongue was thrust about so nimbly that it appeared a wonder it was not impaled perpetually" (Ann. and Mag. Nat. Hist., vol. 20, p. 424, 1847).

After Gosse's account on the insectivorous habits of *Noctilio* comes a different story from Mr. Fraser who collected specimens in Ecuador, and the following note was attached to one of his specimens: "Esmeraldas Nov. 1859; skimming the bank of the river, every now and then making a dash along and actually striking the water catching minute shrimps as they pass up stream."

NOCTILIO AS A FISH-EATING BAT

The most extensive records of the fish-eating habits of *Noctilio* seem to come from specimens collected at Mono Island, near Trinidad. Charles Kingsley, writing of his observations of this bat at Mono Island, has the following paragraph: "As it grew dark, dark things came trooping over the sea, by twos and threes, then twenty at a time, all past us toward a cave near by. Birds we fancied them at first, of the colour and size of starlings; but they proved to be bats, and bats too, which had the reputation of catching fish. So goes the tale believed by some who see them continually, and have a keen eye for nature; who say that the bat sweeps the fish up on the top of the water with the scooplike membrane of the hind-legs and tail. For the last fact I will not vouch. But I am assured that fish scales were found, after I left the island, in the stomachs of these bats; and that of the fact of the picking up of small fish, there can be no doubt" ("At Last," p. 132, 1871).

Not long after this the story was revived by Dr. G. H. Kingsley, who visited Trinidad during the cruise of the Northumbria, and who, like his brother, watched the movements of the bats in question. Under the heading, "Change of Habits in Animals," he published an article in *The Field* (July 14, 1888, no. 1855, p. 53) and states that "On the opposite side of the strait, or Boca, is another cavern which is the roosting place of a colony of large bats, with teeth and wings perfectly fitted for insectivorous feeding. What do they do? Give up insect-hunting, and go a-fishing. They came out in the gloaming, and fluttered

and splashed on the top of the water, and somehow or other caught tiny fish. I floated about many a hot evening to see how it was done; but, though I was close to them—close enough to be nauseated by their detestable scent—I could never quite make up my mind on the subject. On the whole, I was inclined to accept the native idea that they scoop them off the surface with the interfemoral membrane. However it was done, they certainly did catch fish, and eat them; for I found fish-scales and bones in their stomachs, and had microscopical slides prepared to prove it."

These slides were exhibited at the meeting of the Linnean Society on November 15, 1888. But the microscope revealed nothing that, in the eyes of Doctor Günther and Dr. F. Day, could be stated positively to appertain to fish; and the minute iridescent particles, which were at first supposed by Doctor Kinglsey to be fragments of fish scales, were portions of the shining wing-cases of some coleopterous insect.

The next record that I find of the fish-eating habits of *Noctilio* is in *The Field*, April 6, 1893, no. 1893, p. 497, where J. E. Harting published extracts from Professor McCarthy's (Government Laboratory at St. Annes) detailed account of his observations of the living bats and an examination of some of the specimens he procured: "On Dec. 29 I proceeded to Mono Island, and at 9 p.m. visited a cave on the east side of the island on the first Boca. This cave is in a soft shale formation, and the top of the opening is about 7 feet from the water at full tide. The bats were then in an active state and the majority appeared to be flying homewards. There were few fish near the surface of the water, and comparatively little local fishing appeared to be going on. An occasional "suish" now and again far out proved that the bats were trying to secure their prey. Five home bound specimens were secured in the cave about twelve yards from the mouth. The stomach of one specimen, opened within a half an hour, contained much fish in a finely divided and partially digested state. On the morning of the 31st I visited the cave from which the specimens were procured at 3 a.m., and found that the bats had apparently forgotten the previous disturbance. They came flying in dozens, and two specimens were secured. Both contained considerable quantities of fish. . . . . I have opened several other specimens of the bats, and in the majority of cases fish scales were found; but the stomachs of two were perfectly empty."

In a subsequent report McCarthy says: "A microscopic examination of the excrement, collected in the caves frequented by these bats, proved the presence of chitin from a beetle's leg and scales from the wing of a butterfly."

In addition to the above extracts, Harting added the following paragraph: "The stomach contents which I removed from the specimens recently received from Prof. McCarthy have been carefully examined by Prof. Stewart, of the Royal College of Surgeons, who recognized fish scales and fin rays, while one of the prepared slides shows very distinctly the lower jaw with the teeth of some small fish."

I find mention of *Noctilio* as a fish-eating bat in records of a meeting of the Trinidad Field Naturalists' Club, June 2, 1893 (cf. Journal, vol. 1, no. 9204). The president of the club, H. Caracciolo, Esq., described the manner in which these bats captured their prey, "by throwing it up with their interfemoral membrane. Simultaneously they bent their heads towards their tails to seize the fish as it was thrown out of the water. Dr. Woodlock said that early one morning, at Mono, he distinctly saw the bats in this act and was sure that they caught fish and that the bats were not merely dipping into the water. Besides this there was the evidence of J. H. Harting in an article in The Field (no. 1893, p. 497, 1889) in which he proved without doubt that the stomachs of some of these bats sent to him by Sir William Robinson contained fish."

A note by F. M. Chapman of his experiences with this bat at Mono Island, recorded in 1893 (Bull. Amer. Mus. Nat. Hist., vol. 5, art. XIII, p. 206) says: "The cave on Mono Island in first Boca from which so many of these remarkable bats have been secured, seems now to be deserted by them. The two specimens were taken from a large cave-like fissure in Huevos Boca to which the collector was piloted by Mr. Morrison. Their stomachs contained the partially digested remains of fish."

Since 1893 nothing seems to have been published on the habits of this interesting bat until J. E. Benedict's article, "Notes on the Feeding Habits of Noctilio" (Journ. Mamm., vol. 7, no. 1, Feb., 1926). Doctor Benedict gives us ample proof that at this island *Noctilio* does feed on fish. He states that at Mono Island "many rather large bats were flying about with the pelicans, occasionally gliding down to the surface, touching the water it seemed with the membrane between the legs and tail, and then ascending with a sharp turn as they touched the water. It appeared to me that they were fishing and had a community interest with the pelicans as it were, taking the crumbs which fell from their table in the form of dead or wounded fish. I did not actually see them take a fish, but they acted as if they were doing so. If not, why were they flying with the pelicans in the bright afternoon? We could not

TABLE 1

Stomach contents from Noctilio

LOCALITY AND DATE	NUMBER AND MUSEUM	SEX	STOMACH CONTENTS
	Noctilio leporinus leporinus		
Surinam May, 1881	15058 U. S. Nat. Mus.		Remains of many ants (*Solenopsis* sp.), winged. Fragments of a beetle (probably Crysomelidae, of a mole-cricket (*Gryllotalpa* sp.), of a fly (Sapromyzidae), and of a fish—trace
Trinidad January 30, 1884	14422 U. S. Nat. Mus.	♀	Remains of fish (probably Engraulidae) = 100 per cent
Trinidad July 7, 1899	86700 U. S. Nat. Mus.		A soft muscus-like material imbedded with gravel and vegetable debris, together with traces of fish and mole-cricket (*Gryllotalpa* sp.)
	Noctilio leporinus mastivus		
Old Leiza, Porto Rico July 15, 1916	39583 Amer. Mus. Nat. Hist.	♀	Fragments of mole-crickets (Gryllotalpidae); bits of a beetle (Scarabaeidae), of an ant (*Solenopsis* sp.), and of a spider
Old Leiza, Porto Rico July 15, 1916	39586 Amer. Mus. Nat. Hist.	♂	Remains of mole-cricket (*Gryllotalpa* sp.)
Botany Bay, St. Thomas May 18, 1926	72314 Amer. Mus. Nat. Hist.	♀	Fragments of many scarabaeid beetles (2 or 3, including *Phyllophaga* sp.), of an elaterid (*Pyrophorus* sp.), and of a cerambycid (*Lagochirus araneiformis*). Few fragments of a stink bug (*Thyanta* sp.), of an ant (*Solenopsis* sp.), of a cockroach (Blattidae), and several insect eggs (Lepidoptera)
Botany Bay, St. Thomas May 18, 1926	72315 Amer. Mus. Nat. Hist.	♂	Fragments of scarabaeid beetles, of a mole cricket (Gryllotalpidae), of an ant (*Solenopsis* sp.)

TABLE 1—*Continued*

LOCALITY AND DATE	NUMBER AND MUSEUM	SEX	STOMACH CONTENTS
		Noctilio leporinus mastivus	
Botany Bay, St. Thomas May 21, 1926	72316 Amer. Mus. Nat. Hist.	♀	Remains of many ants (*Solenopsis* sp.), two forms, both winged. Few fragments of a beetle (Scarabaeidae) and of a stink bug (*Thyanta* sp.)
Botany Bay, St. Thomas May 13, 1926	72317 Amer. Mus. Nat. Hist.	♂	Fragments of many scarabaeid beetles (2 or 3 species *Phyllophaga*), of an elaterid (*Pyrophorus* sp.), and of a cerambycid (*Lagochirus araneiformis*). Few fragments of a mole-cricket (Gryllotalpidae), of a stink bug (*Thyanta* sp.), and several insect eggs (Lepidoptera)
Botany Bay, St. Thomas May 14, 1926	72504 Amer. Mus. Nat. Hist.	♀	Remains of a great many ants (*Solenopsis* sp.), two forms, both winged. Few fragments of a beetle (Scarabaeidae), and of stink bug (*Thyanta* sp.)
		Noctilio sp. ?	
Paraguay	5228 U. S. Nat. Mus.		Remains of a mole-cricket (*Gryllotalpa* sp.), bits of a fly

get near enough to shoot one, and Mr. Morrison said that we could paddle to where they lived behind a rock. We soon came to a place where the ocean ground-swell broke against a cliff. Here a huge scale rested against the face of the cliff, the opening being parallel with it. Now and then a bat would go in or out. We put the canoe as close as was safe, and fired a charge of shot at such an angle that the shot rebounded into the cleft. Out came the bats, and we shot several as they flew about. An examination of the stomachs revealed the remains of fish exclusively."

Doctor Benedict tells me that the stomachs of these bats contained several very small fragments of fish, but the most conspicuous part was the silvery white cover of the peritoneum of the fishes, which scintillated in the light. There were no fragments of fish of size or character sufficient to identify the species. (See No. 14422, U.S.N.M., table 1, p. 111.)

REMARKS ON SPECIMENS OF NOCTILIO FROM BOTANY BAY

Fifteen specimens were taken, seven males and eight females; one female had one large embryo and another a very small one. One complete specimen and the trunks of four others were preserved in alcohol for an examination of their stomach contents. The color of fourteen adult specimens was: above, snuff-brown, the hairs tipped with buff, with a narrow dorsal stripe of white or yellowish white running from the back of the neck to almost the base of the tail; below, whitish to yellowish, buffy or cinnamon-buff below. No two specimens were exactly alike; the females on an average were more buffy below than the males, though two males, Nos. 72323 and 72325, were as dark a cinnamon-buff as any of the females.

American Museum of Natural History, New York City.

EPIMYS RATTUS IN CAPTIVITY

By Erna W. Mohr

To the courtesy of Mr. Wegener, chief officer of the Hamburg public disinfection works, I am indebted for a live specimen of the domestic rat (*Epimys*[1] *rattus rattus*), which I received in February, 1927. This animal might well be called *var. intermedius* Ninni, as the belly and the sides of it are dark silvery gray, the back dark gray, while the tail is black. I am keeping it in a glass case, covered with brass wire-netting. When standing on its hind legs, the rat can easily touch the netting, but never tries to gnaw it, because keen-scented animals dislike the taste of brass. The cover of the cage is kept down by an iron weight; but I never have seen the rat try to lift it.

The bottom of the box is laid with sand to a depth of about 3 cm., and in a corner of it a large lump of moss has been placed. To hold the food, a glass jar is provided, which the rat likes to get hold of with its teeth in order to move it over the ground, just as my field mice used to do. But while the mice can only drag it, while they walk backward, the rat can also push it forward to the desired place.

The behavior of the animal is a peculiar mixture of that of predatory animals, of dormice, and of mice. The predatory character of

[1] Currently recognized under the genus name *Rattus* by most mammalogists. —*Editor.*

this rat predominates, and the animal is much more intelligent than the rest of my rodents. As a rule, it behaves rather clumsily, according to its size, and moves slowly. When cleaning itself, which takes a good deal of time, it does so most thoroughly and it always looks very smooth and tidy. After scratching itself with its hind foot, it will, mouse-like, lick off its toe-nails. Before scratching its face it carefully shuts the eye on the side to be cleaned before putting its foot to it. Mice, on the contrary, will all of a sudden apply their feet to their faces and often a quick jerk will show that unsuspectingly they have hit their eyes. Unlike the mice, the rat is not content with merely scratching and licking, but also uses its teeth when hunting fleas. Just like a dog, it bites the itching spots drawing back its crumpled upper lip. It never uses its hands for scratching the belly, as dormice are apt to do, but does this by means of the hind feet. And yet it knows better than many other animals how to apply its hands for grasping. Like most rodents in the habit of grasping, it will take up the food by means of the teeth, and hold it in the paws afterwards; but while dormice and squirrels invariably use both hands, my rat frequently takes the food from its mouth by one hand only, keeping the empty hand leisurely propped up.

The rat does not eat greedily. It flatly refuses peas or beans; but it thoroughly enjoys the seeds of sunflowers, and apple-pips; wheat, oats, and hemp seeds are taken occasionally, as well as a little bread, boiled egg, or meat; meal-worms are favorites. The quantity of food taken is very small. Two little mice require more nourishment than this comparatively large animal. At first I used to give it a saucer of water, from which it partook only very rarely; but when I added apples to its food it never touched water again. The demand for apples is quite considerable,—two or three middle-sized ones in three days. By means of the lower teeth the rat bites off a piece large enough to be held in its hands, while mice chew off only a mouthful at a time. The rat does not store up corn, but frequently carries an apple to its lair, and gets rather cross if one tries to take away the hoard. This is done by means of long tweezers, on account of the sharp teeth of the rat, which will sometimes try them on the tweezers. As a rule, it only bites once and jumps back immediately after having bitten. Field mice, when fighting, back out after each bite in the same way. According to their size, the apples are brought into the nest in different ways: small ones the rat carries in its mouth, while it walks forward; larger ones it either drags by means of its teeth, while it walks backward, or rolls them, just as a brewery hand would roll beer barrels.

When resting, the rat takes any position from lying rolled up on one side to lying straight on its belly. Generally it prefers lying on its side and putting its tail, dormouse fashion, over its face, between the ears, and over its back; sometimes, moreover, it puts the tip of the tail across the face again, so that the tail forms a cross over the face. Yawning and stretching can be observed frequently; after yawning, the animal makes a few chewing movements similar to those called "chewing water." When scenting danger, or feeling uneasy, the rat puts back its long ears, which then crumple up somewhat in preformed folds similar to those of *Plecotus auritus*.

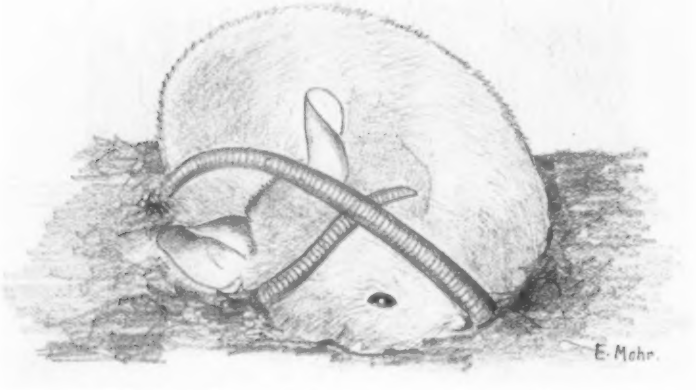

FIG. 1. BLACK RAT IN A CHARACTERISTIC RESTING POSITION

At first the animal was very timid. It was startled by every word and every noise in the room, and breathed hard. But very soon it became accustomed to its two daily roommates and is now quite confident and free with us. At a strange voice or strange step in the room, however, it hurries to its place in the corner and rolls itself up, breathing quickly.

It evidently does not require much exercise; at all events, it never runs about in its cage, unless disturbed, or attacks the wire netting. Frequently it stands up at the glass walls, sniffing and licking at our fingers when we put them on the wire netting, but it never tries to bite through the netting, although the animal evidently is not entirely

harmless. When the animal stands up, the hair-crest formed by the lateral ranges of the hair meeting in the middle of the belly is clearly visible. Sometimes the rat, sitting on an apple, tries to reach the wire netting, but very soon gives up this attempt, an apple being too uncomfortable and insecure for it to sit upon. It very seldom plays. When we are alone, the rat occasionally jumps about, kangaroo-like, on the hind legs; or it jumps into the air moving rapidly and strangely. We can not help taking this behavior for playing in high spirits. It especially does so after a particularly good meal. When we are moving about, it follows us with its eyes, sometimes opening its mouth a little, without, however, looking any the more intelligent. Tobacco smoke it does not seem to mind in the least.

In July, 1927, I was absent for three weeks and nearly all that time my roommate was also absent. During that period the animal was looked after by somebody else, which means it was fed once a day and did not see or hear anything else. When I came back, I called to it when I entered the room. It jumped up at once and never lay down again until it had finished eagerly smelling my hands and face. While I was sitting and working at my desk, the rat jumped about in its cage watching all my movements; when I called it, it sat up at once. It distinctly behaved as if it thoroughly enjoyed our meeting again and as if it recognized me. This observation has been confirmed by an acquaintance, who told me the next day: "Whenever I come into your room, the rat is always lying rolled up and sleepy in its corner; only yesterday, when I came into the room just after you had left, the animal got up. But when I approached it, it got frightened and hid in its lair." This statement of an entirely unbiased person unmistakably shows that this rat is able to distinguish different people and to differentiate its feelings toward them. A second shorter trip of mine also, which had meant loneliness to the animal, ended in the joy of meeting again, which was mutual.

So far, I could always venture freely to reach inside the glass case and remove or replace the food-vessels; the rat would not stir from its place. Naturally, one has to keep an eye on it all the time, for the large eyes and the quick breathing distinctly show how acutely it is on the lookout. I shall not be surprised if precautions will have to be taken one day to avoid my getting bitten or the rat escaping.

I might mention that the animal is no source of offense to the human inmates of the room, since its scant exhalations do not penetrate through the netting. They are only noticed when one puts the nose quite close to the animal.

When digging, the rat uses its fore feet and scratches the sand to below its belly and further back between the hind legs, occasionally pushing the heap still further back by means of its hind feet. When the heap grows too large, the animal turns around and pushes it back with its hands.

I am convinced that our animal—and every other mouse—is in the habit of dreaming. Contrasted to birds, mice never talk to themselves, but to somebody else only. Consequently, mice in captivity, when kept alone, never emit any sounds as long as they are awake. But sometimes, one can see and even hear them sleeping and dreaming. Then their breathing is flat and quickened, their legs and their snouts are twitching, and one hears from them rather strange and surprising sounds. Thus my rat, entirely mute when awake, produces when asleep high long-drawn sounds, comparable to the whistling signal of a starling and very similar to the whistling of my waking dormice (*Eliomys quercinus*), although much less audible.

Zoologische Museum, Hamburg, Germany.

THE PLACENTATION OF HYRAX (PROCAVIA CAPENSIS)

By G. B. Wislocki

[*Plates 11–15*]

The present observations are based upon a pregnant uterus of *Procavia capensis* obtained in Tanganyika Territory by the Smithsonian-Chrysler Expedition. The specimen (U. S. Nat. Museum No. 241540) was submitted to me for study through the courtesy of the National Museum.

The uterus is a round object measuring approximately 4 cm. in diameter (fig. 2). On the dorsal surface of the fundus two short cornua communicate with the oviducts. The oviducts measure some 8 cm. in length. They extend a few millimeters cephalad to the ovary then bend sharply caudalward and terminate in a delicate membranous fimbria which covers the ovary and contributes to the formation of an incomplete ovarial pouch. The ovaries measure 6 x 4 x 1½ mm. The left ovary contains a single corpus luteum which is situated upon its outer edge as a pedunculated nodule measuring 3 x 2 x 2 mm.

Cervix and vagina are lacking in the specimen. A small incision

through the dorsal wall of the uterus reveals a single fetus with undisturbed membranes lying within the uterine cavity. According to the statement of Weber ('04) two to three young are usually born in this species although exceptionally only one. The African hyrax is accredited with two to three young, the Syrian hyrax with four to six according to Brehm ('15).

Brief remarks on the placenta of *Hyrax* were made by Home (1814), Owen ('57), Huxley ('64), Milne-Edwards ('68), and George ('74). Home stated in his "Lectures on Comparative Anatomy" that the placenta of *Hyrax* is zonary like that of the cat. Owen also remarked that the placenta of *Hyrax* is spongy and vascular, resembling in texture that of Carnivora and in a further reference ('68) he adds that its decidual, localized annular placenta resembles that of the elephant. Huxley briefly described it as zonary and deciduate with well marked interlocking of maternal and fetal vessels. On the other hand, according to Milne-Edwards, it is a diffuse, non-deciduate placenta, similar to that of ungulates, with a simple interdigitation of the chorion with folds of the uterine mucosa. George ('74) from some observations on a gross specimen, also adhered to the view expressed by Milne-Edwards.

With these conflicting views in mind Turner ('75) undertook to settle the mode of placentation by reëxamining the specimen of Professor Huxley. The uterus was two-horned; two well developed ova, each about 3½ inches long, were lodged in one cornu. The placenta was zonary. The non-placental areas of the chorion were smooth and translucent, and, as in Carnivora, branches of the umbilical vessels ramified in the membrane. When the placenta was stripped off the uterus, not only was the endometrial wall in the placental zone removed along with the chorion, but also, for some distance on each side of the zone, the mucosa tore away from the muscular coat of the uterus.

Upon careful dissection of the placenta, combined with magnification, Turner ascertained that the placenta consisted of fetal lamellae buried in the mucosa, much in the manner in which fetal and maternal tissues interlock in the placenta of the cat. Moreover, the maternal tissue enclosing the fetal lamellae separated with the placenta after the latter was peeled off from the serotina, so that there was no doubt in Turner's mind that a portion of the endometrium is shed at the time of parturition. Hence *Hyrax*, according to Turner, is one of the Deciduata.

In reference to the fetal membranes Turner described a large allan-

toic sac in his specimen and the absence of a yolk-sac. In concluding his paper he says: "*Hyrax* agrees, therefore, with *Felis*, not only in the form and structure of the placenta, but in the presence of a large allantoic sac. It differs, however, in the condition of the umbilical vesicle, which in *Felis* persists during utero-gestation, but in *Hyrax* disappears apparently at an early period."

In addition to Turner's observations, Assheton ('06) presented a description of two gravid uteri of *Hyrax*. One specimen was a portion of the uterus containing an embryo intact, the other specimen consisted of the placenta, stripped from the muscle coats and containing the embryo. Accompanying the latter was a separate piece composed of a portion of the muscular layer of the uterus. There was no appreciable difference between the two uterine swellings containing the embryos. One contained an embryo which was of a much younger stage than the other, equivalent to about a five-day chick. The other uterus contained an embryo corresponding in stage of development to about a sixteen-day rabbit or thirty-two-day sheep.

Assheton concludes that the placenta of these specimens is clearly of what he has called the cumulate type, and so far as one can judge from an isolated specimen, resembles more closely the type of placenta found in rodents, insectivores (*Erinaceus*), and man. Moreover, it shows no great resemblance to those of elephants, ruminants or carnivores.

As the characteristic features of the placenta, he described a profuse proliferation of the trophoblast over the whole surface of the blastocyst. The trophoblast invades the endometrium, producing a labyrinth of trophoblastic strands in the meshes of which lacunae are situated. Through these lacunae the maternal blood flows. The maternal arteries penetrate to the fetal surface of the placenta and there break up into sinuses and lacunae through which the blood returns between the trophoblastic trabeculae to the maternal veins at the base of the placenta. Only a relatively narrow zone of the trophoblast on the fetal side becomes vascularized by fetal vessels through the ingrowth of mesoderm. Thus the bulk of the trophoblast remains avascular as far as the fetal circulation is concerned and the only region in which the fetal and maternal blood streams are in intimate contact is that of the narrow zone of allantoic mesoblast apposed to the trophoblast on the fetal surface of the placenta where the arterial maternal blood first enters the lacunar labyrinth.

In summary Assheton says that: Firstly, there is no trace of any

lumen of the uterus. Secondly, the trophoblast is equally developed on all sides of the blastocyst, both ends and sides. Thirdly, at this —a comparatively late—stage, the trophoblast remains as a highly vascularized investment completely surrounding the embryo and not attached in any way to the mesoblast which shows no sign of villous formation. And fourthly, the glands of the uterus take no further part in the nourishment of the fetus.

The present uterus contains an embryo of 21 millimeters crown-rump length (fig. 4). The fetal membranes were intact so that a complete dissection of them could be made. The result of this dissection reveals the relationship of the chorion, allantois, amnion and yolk-sac to one another (fig. 1).

The allantoic sac only partially fills the chorionic sac. The allantois appears to have grown out as a bilobed sac into the exocoelome on either side of the embryo. These two saccular diverticulae continued to grow up over the amnion and finally met in a line of fusion with one another above the embryo in the dorsal midline. The allantoic sac at the stage described has surrounded approximately four-fifths of the amnion. But, because the allantois grows neither far anteriorly, nor posteriorly into the exocoelome, the amnion is left bare at both poles. Thus the allantoic sac is annular, surrounding the amnion like a broad girdle (fig. 1).

The umbilical vessels reach the chorion by way of the wall of the allantois, diverging from the umbilical ring as four arteries, each accompanied by a vein, which course to four equidistant points, the corners of a quadrangle, upon the chorionic floor. The allantoic pedicle as it emerges into the exocoelome resembles a flattened quadrilateral pyramid or tent with points of attachment of the allantois and its vessels to the chorion at the four corners of the base of the pyramid (fig. 3). A yolk-sac, measuring approximately 3 x 5 millimeters, lies in the exocoelome against the left lateral wall of the allantoic tent (fig. 4). The yolk-sac has a minute hook-like appendage at its free pole. This appendage suggests a vestige of a former connection of the yolk-sac with the wall of the chorion (fig. 1). This connection may have been severed by the rapid expansion of the wall of the blastocyst and the rapid growth of the allantois or by a reduction in size of the yolk-sac itself.

The chorion consists of two layers, a trophoblastic one and a mesodermal one. The relationship of these layers to one another is curious and on gross examination entirely misleading. If the uterine wall is

dissected without any knowledge of its microscopic structure, it is found that a membrane, presumably fetal, can be stripped away by gentle traction from the inner surface of the uterus. Under a Greenough binocular dissecting microscope this membrane is seen to be covered by short, unbranched villi which were in apposition to the uterine wall and fitted into corresponding crypts or pits in the uterine surface (figs. 5 and 6). If no further examination were made, it might be assumed that the membrane is the chorion which fits by means of short villi into corresponding depressions in the endometrium. Hence the placentation of *Hyrax* might be readily assumed to be of the diffuse type as in the pig, if the investigation had been concluded at this point.

The fallacy of such a conclusion, however, is revealed immediately by examination of microscopic sections through the uterine wall. It is discovered that the membrane which strips off so readily consists solely of chorionic mesoblast devoid of ectoderm and that the latter is represented by a broad layer of trophoblast which is more firmly attached to the endometrium and hence remains in situ. Characteristic of *Hyrax* seems to be the character of the mesoderm which penetrates the trophoblast only very superficially as short villi which separate easily and completely from the trophoblast under gentle traction. If this relationship of mesoderm to trophoblast persists throughout the period of gestation, it is possible that at parturition separation occurs at this junction and that the trophoblast undergoes resorption in situ in the manner of so-called contradeciduate placentae.

Microscopic section reveals beyond a doubt that the structure of the placenta of *Hyrax* is of the burrowing (deciduate) type. The placenta is composed of a broad zone of trophoblast which has penetrated deeply into the endometrium and of a superficial layer of mesoblast possessed of short villi which project into the trophoblast (figs. 1, 7, 8, 9 and 10).

Contrary to Assheton's observations both trophoblast and mesoderm are not equally thick over the entire surface of the blastocyst. In a broad equatorial zone both layers are pronouncedly thicker than at the poles of the blastocyst (figs. 7 and 10). At the poles the villi of the chorionic mesoderm are so flat that they scarcely exist at all, whereas toward the equatorial zone they become increasingly longer. Hence the mesoderm strips more readily over the poles than elsewhere. Moreover, the trophoblastic layer is exceedingly thin at either pole.

The mesoblastic layer consists microscopically of a loose fetal stroma

containing the fetal blood vessels. The villi belonging to this layer enclose a sort of intervillous space composed of large confluent lacunae which contain maternal blood. A thin layer of chorionic ectoderm, like endothelium in character, encloses these lacunae. When the mesoblastic layer is separated from the placenta, the lacunae with the ectodermal lining remain in situ, as the processes of connective tissue are pulled out from between them (figs. 7, 8 and 9).

The lacunae receive the maternal blood through a few relatively large maternal vessels which convey the arterial blood from the arteries of the lamina basalis through the entire thickness of the placenta to the fetal surface where they open into the lacunar spaces. From the lacunae the maternal blood returns to the maternal side of the placenta, to reach the veins, through a labyrinthine network of tortuous channels intercalated between the lacunae and the veins. This labyrinth forms the basal half of the placenta foetalis. The first part of this labyrinth that the blood enters from the lacunae consists of numerous short, straight, channels (fig. 8). These straight channels soon anastomose, however, to form the curious labyrinthine sinuses. Lacunae and sinuses, as well as the intervening straight channels are enclosed by trophoblast. However, the trophoblast, confining the lacunae and the draining straight tubes, is endothelium-like in character, whereas the trophoblast, constituting the walls of the anastomosing sinuses of the labyrinthine portion, is composed of anastomosing strands of dense syncytium.

The chorionic mesoderm with its villi embraces the lacunae and their straight, draining channels and is clothed by the endothelium-like trophoblast lining these vascular spaces. However, the mesoderm terminates at the junction of the straight tubules with the anastomosing sinuses of the labyrinth, so that the trophoblast which constitutes the walls of the sinuses in the basal half of the placenta is completely devoid of fetal mesoderm and consequently of a fetal circulation. Hence the respiratory exchange between the maternal and fetal blood streams is restricted to the fetal surface of the placenta occupied by the wide lacunae. In this zone the trophoblast separating the two circulations is flattened like endothelium and, moreover, it is this portion of the placenta which the arterial maternal blood first enters. The broad avascular trophoblastic zone can be assigned no rôle in the nutrition of the embryo, because of its remoteness from the fetal blood-stream. It appears to be rather a zone of growth for the placenta. Furthermore, when other stages in the development of of the placenta of *Hyrax* are obtained, it may be found that much of

this zone eventually becomes vascularized. At any rate the exceedingly retarded and restricted growth of the mesoderm into the trophoblast seems to be a characteristic feature of the placentation of *Hyrax*. The author is not acquainted with any similar condition in other forms, unless it be in *Tarsius*, for the condition detailed here shows a striking resemblance to a stage in the development of the placenta of *Tarsius* as described and pictured by Hubrecht ('98) (fig. 11). It is also reminiscent of the development of the ectoplacenta in some insectivores and rodents.

In this specimen the trophoblast terminates beneath the labyrinth along a line of contact with the uterine tissue. The trophoblast forms here a palisade-like terminal border of syncytium. In contact with this border is a narrow zone of altered and partly necrotic endometrial tissue. Enormous giant-cells, staining differently than the trophoblast and having no cytoplasmic connections with it, are scattered through this zone (fig. 10). These giant-cells are presumably of maternal origin and arise by a plasmodial transformation of endometrial tissue.

The majority of these giant-cells exhibit a crescentic arrangement of some ten to twenty nuclei along the border of the cell with a clear field in the center of the cell. The giant-cells are more numerous at the poles of the placenta than near the equatorial zone where the trophoblast is thickest.

Between this decidual zone and the uterine musculature is a layer of endometrium composed of loosely arranged connective tissue elements. In this layer the uterine glands are visible. The glands, however, are exceedingly small and wide apart, with scarcely any lumen. The largest ones appear no larger than small rings composed of less than half a dozen cells. Moreover, the glands are so infrequent that often in a section of more than a centimeter in length not a single gland is cut.

The blastocyst is found to occupy the lumen of the body of the uterus. The cornua are short and empty, more of the lumen of the right cornua being occupied than of the left. Implantation appears to have been of the central, rather than of the excentric or interstitial type, because there is no evidence of the existence of a capsularis.

DISCUSSION AND SUMMARY

Hyrax possesses a typically deciduate placenta exhibiting certain special features. It is related most closely to the type of placenta found

in the insectivores, rodents and *Tarsius* and is of the type designated as a placenta hemo-chorialis by Grosser. It bears no resemblance to the diffuse type of placenta found in ungulates. Moreover, in its microscopic structure, it is not related to the placenta endothelio-chorialis found in carnivores.

Genetically, from a consideration of its morphology and the findings of paleontology, *Hyrax* is placed by the most conservative estimate close to the ungulate stems in rather close affinity to the Proboscidea. Moreover, it is considered to be more closely related to the proto-ungulate stock than any of the existing ungulates or Proboscidea.

In reference to placentation, however, it bears no resemblance to the existing ungulates or to the Proboscidea. In the latter, according to Assheton ('06), placentation resembles that of certain ungulates, particularly the sheep.

The author believes for reasons given in detail in another publication ('27) that there is much evidence to support the view that the diffuse placenta as found in Lemuridae, Cetacea, Artiodactyla, Perissodactyla, Proboscidea and Sirenia is a secondarily derived form of the placenta. The mammals possessing that type of placenta are highly specialized, extremely divergent groups. On the other hand, the mammals that are considered to be archaic and close to the stems are nearly uniformly possessed of the burrowing type of placenta, for example, some Marsupialia, the Xenarthra, Insectivora, Rodentia, and Carnivora.

The placentation of *Hyrax* is in accord with such a view. In *Hyrax* we are dealing with the most primitive form (in many respects) of the existing ungulates and one bearing close affinities to fossil proto-ungulates. Hence it is not surprising to encounter the primitive burrowing type of placenta.

Whether the placenta of *Hyrax* shows in any way a transition from the burrowing to the diffuse type of placenta must await a complete knowledge of its development. The observations that the blastocyst is, up to a relatively late period, entirely covered by placenta, and that the mesoderm at the same period shows no more than a mild proliferation with the production of only short villi which are superficially connected with the trophoblast, may be found, when more material is available, to illustrate a stage of transition from a burrowing to a diffuse type of placenta.

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EXPLANATION OF PLATES

PLATE 11

FIG. 1. Semidiagrammatic drawing by James F. Didusch, showing the opened uterus with the fetus in situ, surrounded by the intact membranes. *Allant. 1, 2, 3, 4*, processes of the allantoic sac touching the chorion at the points where the allantoic vessels penetrate the chorionic wall; *allant. ves.*, the allantoic blood-vessels in pairs, composed of an artery and vein, forming four pedicles connecting the fetus with the chorion; *amn.* amnion; *ch. m.*, chorionic mesoderm; *ch. villi*, villous prolongations of the chorionic mesoderm which penetrate the inner portion of the trophoblast, enclosing maternal lacunae; *exoc.*, cavity of exocoelome; *fet. ves.*, fetal vessels within the stroma of the chorion; *m. art.*, maternal artery; *m. sin.*, maternal sinusoids; *m. vn.*, maternal vein; *tr. 1*, trophoblastic syncytium surrounding maternal sinusoids; *tr. 2*, border of the trophoblastic syncytium in contact with the endometrium; *ut. wall*, wall of the uterus.

PLATE 12

FIG. 2. View of unopened gross specimen of uterus. × 1½.

FIG. 3. View of opened uterus, with embryo and membranes removed, showing the interior of the chorionic sac and the four points of attachment of the allantoic vessels to the chorion. Around each pedicle a bit of the allantoic membrane can be seen. Along the cut edges of the uterine wall, the tendency of the chorionic mesoderm to separate as a sheet from the placental labyrinth can be seen. × 2½.

FIG. 4. View of the embryo (21 mm. crown-rump length), showing the small yolk-sac lying in the exocoelome. × 2½.

PLATE 13.

FIG. 5. A portion of the chorionic mesoderm which has separated from the placenta, showing the character of the short villi which attach to the trophoblast. × 20.

FIG. 6. A corresponding view of the placenta after the chorionic mesoderm has been stripped off, showing the crypts in the labyrinth into which the mesodermal villi fit. × 20.

PLATE 14

FIG. 7. Section through the thickest portion of the placenta, showing the chorionic mesoderm as a sheet, with prolongations which dip down and surround the maternal lacunae. A few of the relatively straight, short vessels that drain the lacunae can be seen. The course of these channels is lost in the labyrinth that occupies the middle third of the section. The dark network seen in this labyrinthine zone is composed of trophoblastic syncytium. Beneath the labyrinth, its palisade-like border may be seen in contact with the loose stroma of the endometrium. No giant-cells or glands are visible in the endometrium in this region. The clear spaces at the junction of the straight vessels with the labyrinth represent the line of separation and limit of penetration of the chorionic mesoderm. × 55.

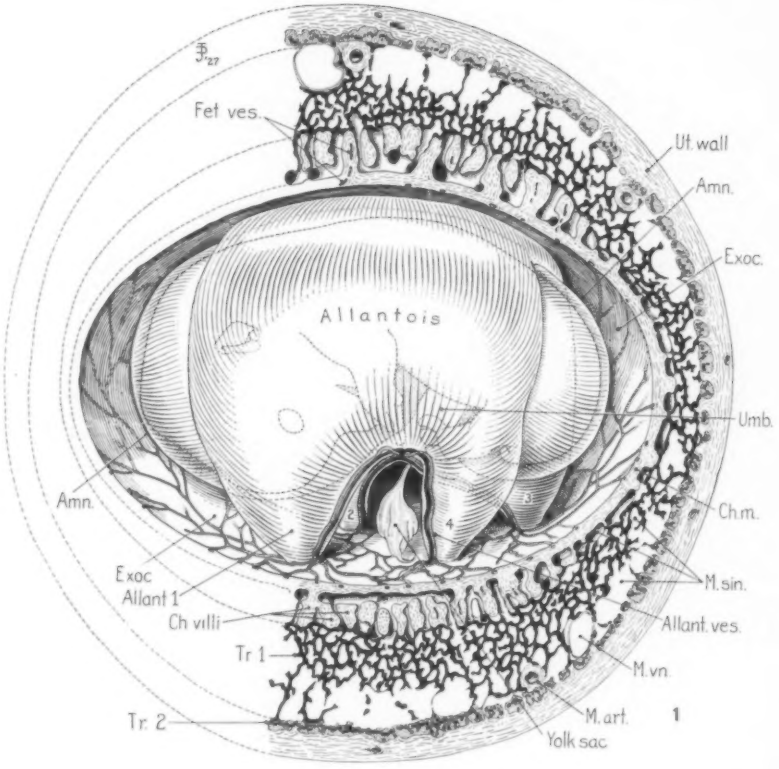
FIG. 8. Higher magnification of a lacuna, showing its efferent channels leading into the labyrinth. Note the clefts formed by a slight separation of the mesodermal villi. × 125.

PLATE 15

FIG. 9. Section showing the separation of the mesodermal villi from the trophoblast. The bulbous masses are the lacunae enclosed by an endothelium-like layer of trophoblast. × 125.

FIG. 10. Section of the placenta near a pole of the blastocyst showing how much narrower it is. To the left of the figure the mesoderm has separated from the trophoblast. Note that the mesodermal villi are quite short. Moreover, note that in this region beneath the trophoblast in the endometrium there is a conspicuous layer of giant-cells. × 55.

FIG. 11. Drawing taken from Hubrecht's paper on the placentation of *Tarsius* ('98), showing the similarity in the microscopic structure of the labyrinth at this stage in *Tarsius* and *Hyrax*. Less than half of the trophoblast has become vascularized by the ingrowth of mesoderm.



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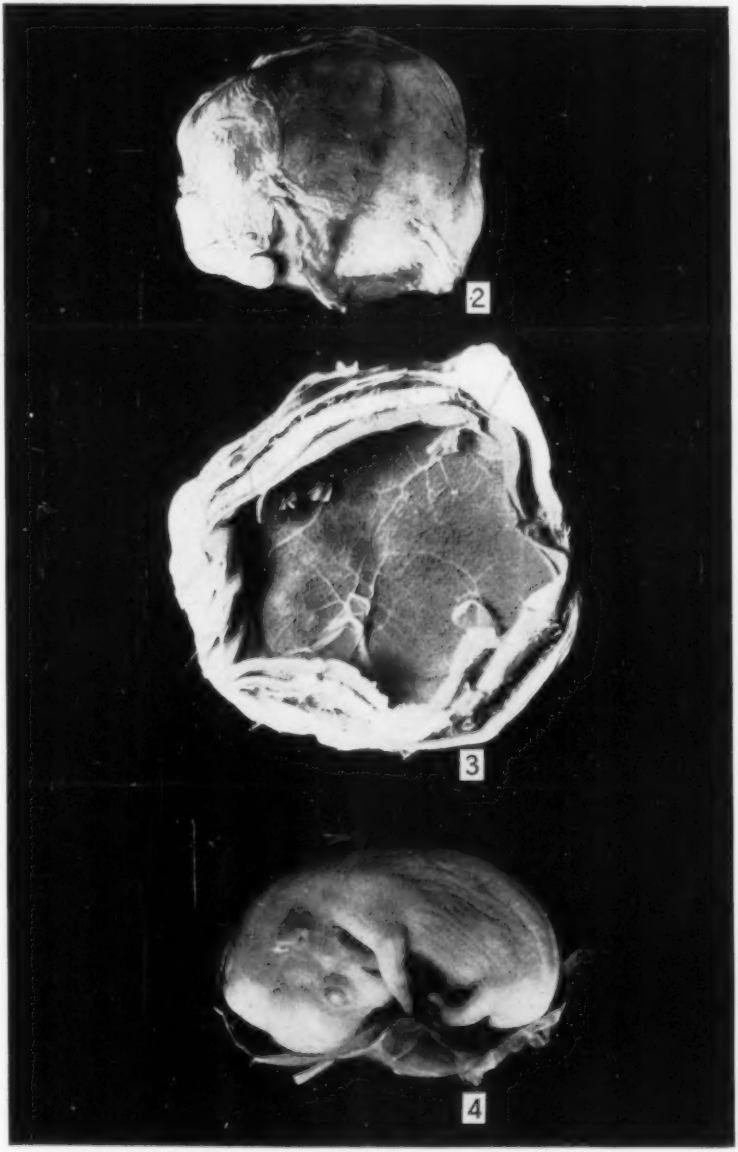

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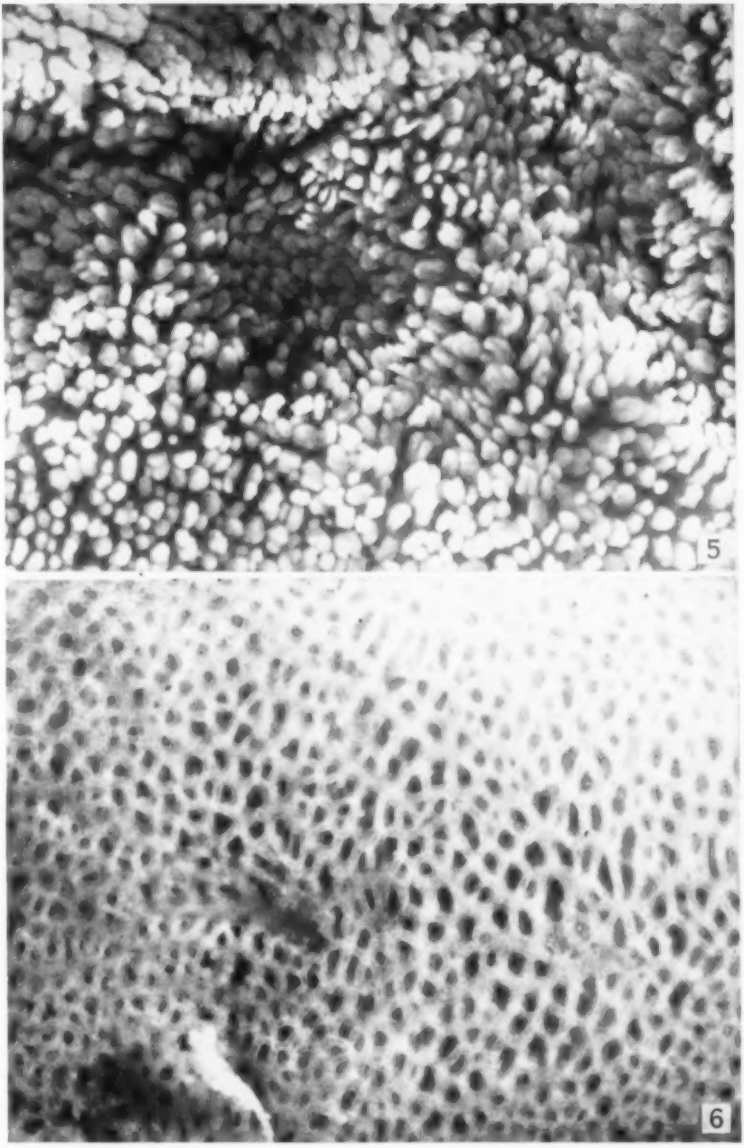

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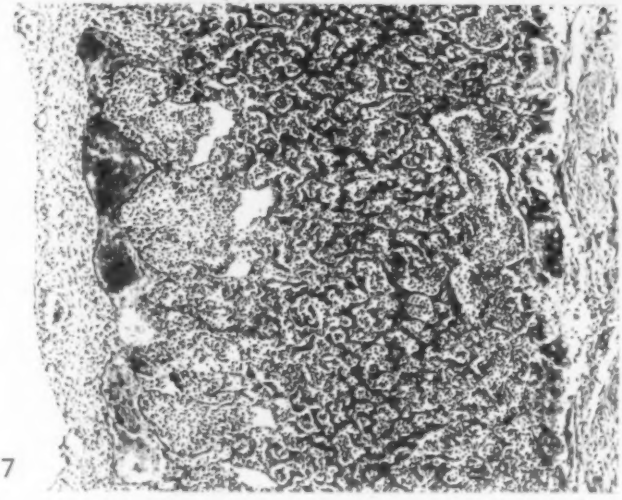

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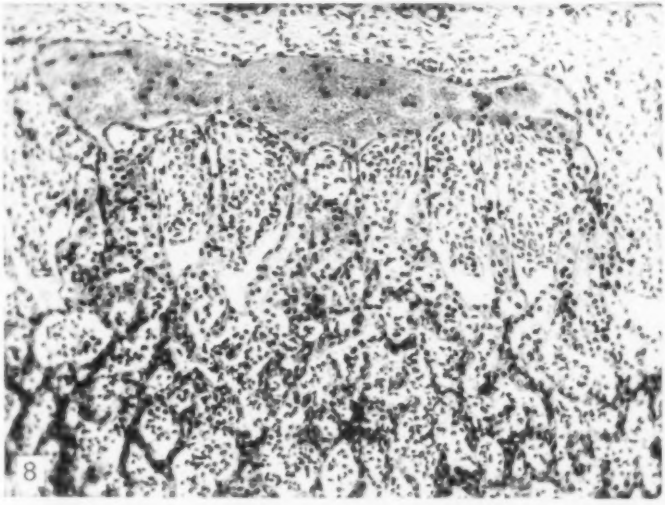

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(Wislocki: Placentation of Hyrax)

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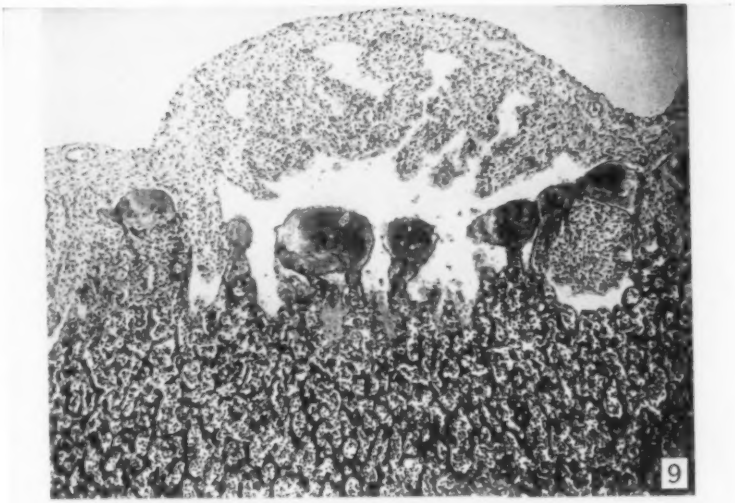

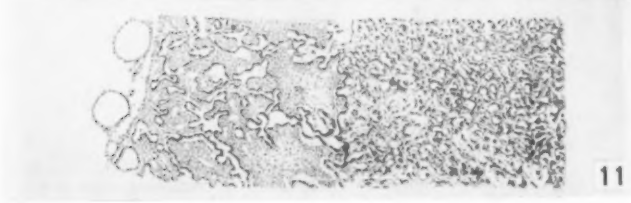

(Wislocki: Placentation of Hyrax)

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THE KAIBAB OR WHITE-TAILED SQUIRREL

By E. A. Goldman

[*Plate 16*]

Among the handsomest of our tree squirrels are *Sciurus aberti*, with its various subspecies, and a close relative, the Kaibab or white-tailed squirrel, currently recognized as *Sciurus kaibabensis*. These range as a group in the yellow pine forests along the backbone of the continent from Colorado south to Durango, Mexico, and west to the high plateau region cut by the Grand Canyon of the Colorado in Arizona. Typical *S. aberti* occurs along the southern rim of Grand Canyon and in earlier geologic time its range probably included the lofty Kaibab Plateau. With the excavation of the canyon, however, the small colony now known as *S. kaibabensis* was isolated in the Kaibab loop on the north side. It is restricted to the yellow pine forested part of the plateau, an area about 40 miles in length and about 20 miles in greatest width near the southern end. Like many similarly isolated forms it has become markedly differentiated, and may be regarded as an illustration of a distinct species in the making.

The squirrels of the *S. aberti* type, including *S. kaibabensis*, are dis-distinguished from all of the other American species by the possession of long dark ear tufts, which reach their greatest development when the winter pelage is prime and are dropped in the summer molt. These tufts, seen from a short distance, give the ears the appearance of great length. The typical Abert squirrel has a gray back except for a dorsal chestnut spot, a grayish tail and white underparts. In the Kaibab squirrel the chestnut area is considerably enlarged, the underparts are black and the broad tail, in marked contrast, is nearly snow white. The occurrence of unusual specimens of *S. aberti* from the south side of Grand Canyon with blackish underparts, or grading toward *S. kaibabensis* in other characters, however, shows the close relationship of the two. The white-tailed squirrel is very showy and conspicuous, whether on the ground or in a tree. When on the ground, the large waving white tail may, at first glance, give the impression that the animal is a skunk, but its identity is quickly revealed in part by its agility and grace of movement. It is of large size and lacks the vivacity of many smaller squirrels.

The habits of all of the squirrels of the *S. aberti* group appear to be essentially the same. They are very closely associated with the yellow

pine and wherever they occur are rarely or never seen beyond the local range of this tree. On the Kaibab Plateau the altitudinal range is mainly from 7,000 to 8,500 feet. Yellow pines are rarely hollow and I have never seen one of these squirrels enter a hole. Dome-shaped nests, about 2 feet in diameter, made of cut pine branches, are usually well concealed among crowded limbs in the upper part of a tree. Like most squirrels the white-tail is most active during the early morning and late afternoon, but may be found abroad at any time of day. Practically nothing seems to be known of its breeding habits. E. R. Hall recorded finding a female with mammae indicating she was suckling young, June 28.

The white-tailed squirrel gnaws the cones of the yellow pine, but as this tree produces few seeds except in good seed years that come at irregular intervals it must depend largely upon other food. It seems doubtful whether any stores are gathered, the cambium of the pine providing a never-failing food supply. In feeding, the leaf-bearing branch tip is commonly severed and allowed to drop to the ground. A subterminal section of tender stem 2 to 4 inches in length is cut off, scaled, and when the cambium sought as food has been neatly removed the peeled wood remaining is also dropped. While branches are cut at all seasons of the year, evidence of the specialized feeding habits of these squirrels is most abundant in winter. Tracks in the snow indicate where they have passed between trees standing some distance apart. A preference for certain trees seems to be exhibited, and it is not unusual to find the snow under these thickly strewn with the discarded branch tips and peeled stems. In summer, however, they evidently indulge in a more varied diet. Much time is spent in foraging upon the ground and I have at various times observed them feeding upon mushrooms and other funguses, and they doubtless eat many other things.

The reports of some observers have suggested that the Kaibab or white-tailed squirrel may be decreasing in numbers. These have been based largely upon definitely known cases of the killing of these squirrels by hawks. During repeated visits to the Kaibab Plateau covering most seasons of the year the writer has not, however, found evidence that hawks are more abundant there than within the range of *S. aberti* on the south side of Grand Canyon. The Cooper hawk is not uncommon and doubtless preys upon the squirrels to some extent, but general observations indicate that the white-tails are about as numerous as the Abert squirrels in any pine forest of equal extent. Several may

KAIBAB SQUIRREL

Photograph from life by William P. Osborn, taken July 12, 1924, near Bedivere Point in the southwestern part of Kaibab National Forest, Arizona. It represents the end of a long stalk during which several unsuccessful snaps were made. Finally the squirrel climbed the tree shown in the picture and began working on a green cone, which it soon dropped and came down to retrieve. The photograph was then taken.

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often be seen in a day's ride through the woods. The destruction of much ground cover through overbrowsing by deer may, however, expose the squirrels to some additional danger from hawks. Squirrels everywhere vary in numbers from year to year owing to causes imperfectly understood, but at present there seems to be no great danger of the extinction of the white-tail. These beautiful squirrels are objects of great interest to tourists along the Grand Canyon highway that bisects the Kaibab Plateau, and efforts should be made to establish them in other yellow pine forested areas. Care should, however, be taken to prevent mingling with any of the other forms of the Abert type east of the Colorado River as the result would probably be a cross-bred race without definite distinctive characters. Some of the denser yellow pine stands on national forests in southern Utah are similar to those on the Kaibab Plateau and might successfully be stocked with white-tailed squirrels.

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THE FORMER RANGE OF THE BISON IN THE ROCKY MOUNTAINS

By F. M. Fryxell

In a former paper[1] published in this Journal the writer reviewed the literature bearing on the high altitude range of the American bison in the Rocky Mountains and reported the finding of a number of bison remains in the Medicine Bow Mountains of Wyoming at altitudes ranging from 9500 to almost 12,000 feet. A second contribution,[2] by Edward R. Warren, appeared in a later number of the Journal, reporting similar field data from Colorado. In the meantime the writer has had opportunity to make some further investigations of the subject, and several field naturalists whose work has brought them into the higher portions of the Rocky Mountains in Colorado, Wyoming, and Montana have contributed their observations. The material from

[1] F. M. Fryxell. A New High Altitude Limit for the American Bison. Journal of Mammalogy, vol. 7, no. 2, May, 1926. Pp. 102–109.

[2] Edward R. Warren. Altitude Limit of Bison. Journal of Mammalogy, vol. 8, no. 1, Feb., 1927. Pp. 60–61.

these various sources has been assembled and is summarized in the following pages.[2]

COLORADO

J. D. Figgins has written as follows, under date of May 27, 1926.

I have lately been making investigations of bison remains, fossil and otherwise in Colorado. . . . . There are many peaks and ranges in Colorado having an altitude in excess of tree growth (approximately 10,500 to 11,000 feet). I recall none that is not more or less accessible to horses, and hence, bison also. I might say there is not one, outside the national parks, that is not pastured by sheep at the present time, often to the summits of peaks quite 14,000 feet in altitude. Mount Lincoln and Mount Bross [in Mosquito Range, Park County] illustrate the general condition of Colorado mountains and horses are ridden nearly to the summit of both.

South Park, between 9,000 and 10,000 feet altitude, was once the range of great herds of bison and pronghorn. A few of the latter are still found there and remains of the former are not uncommon above timberline on the range bordering the park on the west. Personal finds of that character have not exceeded 12,000 feet but I have it from reliable sources that parts of skulls have been observed at points higher. I have no reason for questioning it, since there are no obstructions on either Mount Lincoln or Mount Bross to hinder higher ascent, and grass is luxuriant to near their summits.

Tarryall Range is the eastern boundary of South Park and separates it from Lost Park, a lesser area having an altitude of 10,000 or more feet. It was there the bison made their last stand in Colorado. As late as 1910 there were occasional rumors of bison being seen there and while there is strong evidence that some survived until as late as about 1890, the last examples killed were taken in 1874. While a portion of the herds of bison found in South and Lost Parks may have been migratory, the evidence is conclusive that many wintered there, as did the pronghorn.

There are five specimens in the Colorado Museum of Natural History that were killed in Lost Park presumably during January and February, 1871. I have never seen an equal length of hair over their bodies, but that of the lower forelimbs, neck and throat, is comparatively short, probably due to the character of vegetation of their habitat. I am informed bison remains are quite numerous in Lost Park. . . . . I am confident you may assume that bison once ranged practically all the areas above timberline in Colorado.

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[2] I wish to express my great obligation to those who have contributed data incorporated in this paper. By far the most of it came unsolicited. As will be seen from the following pages, my obligation is especially great to J. D. Figgins, director of the Colorado Museum of Natural History, Denver, Colorado, and Roger W. Toll, superintendent of Rocky Mountain National Park.

In a later letter (dated September 7, 1926) Mr. Figgins submits further data obtained during the summer of 1926:

> I have two further records from Mt. Bross, Colorado, that show the range extended to above timberline, which at that point is about 11,000 feet. . . . . The top of Mt. Bross, as well as that of the adjoining peak, Mt. Lincoln, is easily accessible with horses, and there is no reason to doubt that bison ranged practically all of the heavily grassed area there. Other records from the Tarryall Range are similar to those I mentioned in an earlier letter, but at lower altitudes—around 10,000.

Rocky Mountain National Park

At the suggestion of Mr. Figgins, Roger W. Toll, superintendent of Rocky Mountain National Park, made a careful inquiry into the question of the former range of the bison in the national park and brought to light much interesting evidence relating to the subject. This was submitted to Mr. Figgins (under date of July 23, 1926) who in turn placed it at the disposal of the writer. The data have been somewhat condensed and are here published for the first time. They form a valuable contribution to the subject of this paper and to our knowledge of the natural history of the Rocky Mountain National Park.[4]

George R. Eastman, who for many years has spent his summers in Allens Park and whose winter residence is Dayton, Ohio, gave Mr. Toll two teeth that he had taken from a skull found on July 9, 1909, in Wild Basin. These were identified by Mr. Figgins as from the left side of the upper jaw of a bison. Mr. Eastman stated that the skeleton was on a bench east and a little north of Mount Copeland at an elevation of about 10,500. It was lying at the edge of a large grassy meadow through which a small stream was trickling. This open meadow extends with an easy slope to timberline, which is plainly in view, and probably not more than a mile distant from the point where the skeleton was found.

Curtis K. Skinner, national park ranger stationed at Wild Basin, informed Mr. Toll that a year or two ago he had noticed some bones in that vicinity. He brought some of these to Mr. Toll, who pronounced them probably those of bison.

Mr. Toll writes as follows:

> On August 26, 1922, I was in the vicinity of Chambers Lake at the headwaters of the Cache la Poudre River. One of the men whom I was with (but whose

[4] Mr. Toll has kindly furnished the writer with a topographic map of the Rocky Mountain National Park on which he has indicated the location of each of the regions mentioned in his notes.

name I do not now recall) showed me the remains of a buffalo skull near Chambers Lake and a short distance northeast of it. I would say that the location, as shown on the Home Quadrangle, would be the N. E. ¼ of Sec. 6, T. 7 N., R. 75 W. The elevation would be about 9,200 feet. He also directed me to an open grassy meadow a mile or so east of Chambers Lake where I found the remains of another buffalo skull. This location is . . . . the S. E. ¼ of Sec. 5, T. 7 N., R. 75 W. My companion told me of a skull that he had at his cabin, that was more perfect than either of these two that I saw. Later he sent this to me in Denver and I had it mounted and gave it to the Cactus Club, where it hangs in the club rooms at Fourteenth and Glenarm Streets. This skull was found in that same vicinity, though I do not know the exact location.

Abner E. Sprague came to Colorado in 1864. In 1870 and 1871 he hunted buffalo on the plains at Bruce Johnson's ranch in the American Bottoms on the Platte River trail below the present site of Brush. Buffalo were abundant in those years.

Mr. Sprague first came to Estes Park in 1868. The trip was made with a pack outfit, with two companions. They came to Estes Park about noon of one day and camped along the Thompson River in the meadows below the present site of Estes Park village. The following afternoon they went to the North Fork of the Thompson River, past the present location of Glen Haven. While making this trip, Mr. Sprague remembers seeing a few buffalo skulls lying on the ground in the north end of Estes Park.

Mr. Sprague made another trip to Estes Park in 1872 and another in 1874, and came to the park to live in 1875. In 1877 or 1878 he made his first trip to Hallett Glacier, then unnamed. Acting as guide for two English hunters, he went from Lawn Lake around the east slope of Mummy Mountain, across the pass between Mount Dunraven and Hague's Peak, and thence to Hallett Glacier. A short distance south of the pass and on the east slope of Hagues Peak, at an elevation of 12,100 or 12,200 feet, Mr. Sprague found an unusually large, well preserved buffalo skull and horns.

In 1877, while guiding in North Park, Mr. Sprague found the carcass of a bull buffalo that had died or had been killed a few days before. The location was between the Illinois and Grizzly forks of the North Platte River, along an old Indian trail on the south side of North Park.

Mr. Sprague has no doubt but that buffalo crossed back and forth over the continental divide, and that they went wherever the grazing was good. The grass above timberline, and on the less rugged mountains, must have tempted them often. He believes that the game trails were worn as much by buffalo as by elk and deer.

Howard P. James, of Estes Park, tells me that he remembers as a boy seeing buffalo skulls and buffalo horns in the north end of Estes Park, in Horseshoe Park, and east of Mary's Lake.

William E. James came to Estes Park in May, 1875, and located about three miles northeast of the present village of Estes Park, near the southeast corner of the N. E. ¼ of Sec. 18, T. 5 N., R. 72 W. This location is now known as McCreery Gulch and lies about a mile south of Gem Lake. Dr. Homer E. James

was eight years old when his father moved to Estes Park, and Howard P. James was about four years old at that time.

Dr. Homer E. James tells me that he remembers buffalo skulls in the McCreery Gulch so thick that one could almost cross the gulch by stepping from one to another. These skulls were on the northwest side of the present Devil's Gulch road. Lower down in the gulch, that is on the southeast side of the road, there were many buffalo wallows that looked as though they had been recently used, although actually it must have been fifteen years or more since buffalo were in that vicinity.

Dr. James says that in the next gulch to the northeast, known as the Caley Cook Draw, there were also more skulls and buffalo wallows.

He says that at the time the Estes Park Country Club was built some ten years ago, two or three buffalo horns were picked up near the present building. He also remembers buffalo skulls being found in what is known as the Clauser Draw east of Mary's Lake and at other points near the lake.

E. B. Andrews came to Estes Park in 1896. He found a buffalo skull in Moraine Park and has found horns in other locations. He also remembers the buffalo horns that were picked up on the Country Club grounds about 1915 to 1917.

Peter Hondius says that a pair of buffalo horns were found in Horseshoe Park.

Shep N. Husted came to Estes Park in 1887. He says that there were sixteen buffalo skulls at Dunraven Meadows on the North Fork of the Thompson, near the east line of Sec. 18, T. 6 N., R. 73 W. This location is shown on the Mount Olympus quadrangle as Dunraven Park. Husted says these were probably killed farther up on the North Fork of the Thompson and the skulls were brought to Dunraven Park by the hunters. He has found three buffalo skulls above Lost Lake near the headwaters of the North Fork of the Thompson. These skulls and other buffalo signs were found at an elevation of from 11,000 to 11,500 feet in Sec. 7, T. 6 N., R. 73 W. Some of them were above timberline. He says that the upper end of the North Fork was difficult of access, and was not as much frequented as the region around Estes Park, no cattle were ranged up there in the early days, and that buffalo remained in that neighborhood as late as 1876.

Indian Record

In July, 1913, Miss Harriet W. Vaille (Mrs. F. E. Bouck) arranged for the Colorado Mountain Club and other organizations to have three Arapaho Indians brought to Estes Park from a reservation in Wyoming. The oldest of the Indians, Gun Griswold, was 73 years old at the time of the trip, and Sherman Sage was 63 years old. Both of these Indians had been in the Estes Park and Grand Lake region as boys, and had quite a clear recollection of places and events. The third Indian was Tom Crispin who acted as interpreter, since neither of the older Indians spoke English. The Indians were accompanied on their trip by Shep N. Husted, Oliver W. Toll, and David Hawkins. The following data are taken from the report of Oliver W. Toll regarding this trip with the Indians.

The Indians said that the Arapahos left this region to follow the buffalo north where they had been driven by the advance of the white man. They said that buffalo ranged all through the mountain parks, though of the enormous quantities of game which once inhabited this country there is now to be found little trace, only occasionally a nearly obliterated skull or bone. Sometimes the Arapahos would have considerable difficulty in killing game, while at other times they would come upon little enclosed parks which would be literally covered with buffalo, so that the whole bottom of the valley would be dark with them. The Indians referred to these small parks as "game bags."

The Indians said that at one time they had gone quite a while without finding game, and then came upon a herd of buffalo in one of these little parks. There was no means of egress from the park except the route by which the Indians entered, so that the buffalo were unable to escape. Sage's father then rode right through the herd, picking out the biggest and fattest buffalos, and killing perhaps a dozen of them. When they shot or speared game, they generally aimed to strike between the last two ribs. They pitched their camp in the "game bag" and skinned and cooked the buffalo only a few yards from the rest of the herd, which gradually edged its way around and went out by the trail on which the Arapahos had entered.

Griswold said that Thatchtop Mountain, which reaches an elevation of 12,600 feet, was called by the Indians "The Buffalo Climb" (Haathaanon-Tahou hut). He said that one winter a herd of buffalo cows climbed high up on the slope of Thatchtop and were caught there by the snow. The slopes of Thatchtop are so steep that cattle would not be apt to climb them, but it is altogether possible that buffalo could have worked their way up the eastern slope.

At the time the Indians revisited this region, the name "Sheep Mountain" applied to the entire ridge extending from what is now known as Giant Track Mountain to Lily Mountain. The Indians said that their name for one of these points was "Where the Buffalo was Chased" (Anacha taanxunant: buffalo-chased-up). The story is that while a large number of Indians were camping in Tuxedo Park, the horses were being herded at the foot of Sheep Mountain on the eastern side. One day some of the boys herding horses saw a buffalo and chased him well up the side of the mountain.

In the east end of Tuxedo Park along the west bank of the creek, the party found buffalo and elk bones, and partly buried charcoal ashes. These ashes marked the fires built in the center of the tents. This had been a big hunting camp.

There was a park on West Creek which the Arapahos called "One-horn Buffalo Park" (Anacha-tabaanathat: buffalo-one-horned) because they had once killed a buffalo there which had lost one of its horns.

In North Park there were some mountains that the Indians knew as Buffalo Mountains. This is perhaps the same as the present Buffalo Peak. Buffalo Pass, between North Park and Laramie Plains, was called by the Indians, "The Buffalo Trail" (Anacha-bahahah: buffalo trail).

The Indians said that there was a buffalo trap in Long Gulch near Estes Park, Mount Olympus quadrangle, where the buffalo were driven through a narrow opening where hunters were stationed to kill the game.

The Indians' name for Grand Lake was "Big Lake" (ahbanth-naach), but they

also called it "Holy Lake" or "Spirit Lake" (batan-naach: holy lake). They said that the lake had once frozen over, with a little patch of water in the center of the lake, and that when the snow was on the ice, the Indians had found many tracks of buffalo on the lake. The tracks of one especially large buffalo seemed to come from the center of the lake and to return there. They concluded, therefore, that some enormous supernatural buffalo must live in the lake, from which they called it "Spirit Lake."

In the vicinity of Grand Lake the Indians related that one time as they were moving camp a buffalo, which some of the young warriors in the rear had started up, charged through their pack outfit and stampeded all the horses. It took them the better part of the day to collect their things again.

To the foregoing discussion may be added a communication to the writer from Prof. Arthur B. Sperry of Kansas State Agricultural College, who states that he found a bison skull a couple of years ago on Roaring River, about half way between Horseshoe Falls and Lawn Lake, along the trail to Lawn Lake at an altitude of at least 9700 feet.

WYOMING

Medicine Bow Mountains

In the course of a visit to the Medicine Bow Mountains made in June, 1927, the writer found three more or less complete bison skeletons near the crest of the Snowy Range at altitudes of nearly 12,000 feet. They were found within half a mile of where the bison remains previously reported[5] were discovered, and furnish added evidence in support of the conclusions then reached. Dr. J. J. Runner of the State University of Iowa has also reported to the writer the finding of bison remains at an altitude of 10,500 feet on the west slope of this range.

Jackson Hole Region

The writer spent portions of the summers of 1926 and 1927 in and about Jackson Hole, south of Yellowstone Park, in northwestern Wyoming, and had occasion to make numerous inquiries and observations there regarding the present subject. A detailed account of these is probably not necessary, and it is sufficient to state that from the statements of old settlers and the evidence of bison remains it is clear that this mountain basin was ranged by bison prior to the time of white occupation, although this basin is more severely and completely enclosed by mountains than any other occurring in the "buffalo country."

[5] F. M. Fryxell, op. cit.

Whether or not bison were able to winter in Jackson Hole is a question the writer has not been able to answer with finality. However, old residents of the region questioned on the subject were of the opinion that bison invaded Jackson Hole and the adjacent mountains during the summer season only. To the writer this seems highly probable in view of the long, severe winters and the heavy snows that are experienced in most of the region. If bison ever wintered here it must have been in the southern portion of Jackson Hole, in the vicinity of Jackson, where the snows are relatively lighter. Bison remains are said to be frequently found near this town.

If bison were unable to withstand the heavy snows and rigors of winter in the Jackson Hole region, it is probable that the skulls and bones that may still be picked up are those of animals caught by cold weather on their summer range.

The distribution of the bison remains found by the writer or reported to him seems significant. They have been found (1) along the Buffalo River (hence the name), northeast of Jackson Hole; (2) along the Hoback River, south of Jackson Hole; (3) at a few points on the western slope of the Gros Ventre Range, especially east of Jackson; and (4) at various points on the floor of Jackson Hole.

As regards the occurrence of bison remains along the Buffalo River, one or both of the following explanations may serve: the animals may have worked their way westward from the Wind River Basin and through the Wind River Mountains by way of the Wind River Valley and Twogwotee Pass, descending the valley of the Buffalo River into Jackson Hole; or they may have gained access to Jackson Hole by some of the other possible routes and made their way from the Hole eastward up the valley of the Buffalo River, where the summer grazing must have been excellent for bison as it now is for elk.

The bison remains found in abundance along the Hoback River, south and southeast of Jackson Hole, no doubt record the route by which bison migrated back and forth between the Green River Valley and Jackson Hole. Both this route and that of the Buffalo River Valley are today important avenues through the mountains into Jackson Hole and are followed by state highways.

Bison remains in the Gros Ventre Mountains could be either those of animals that came from Jackson Hole and grazed their way up onto the comparatively gentle slopes to the east, or those of animals that entered the mountains from the Green River Valley and made their way westward through this rugged mountain country almost or quite

to Jackson Hole. There is abundant evidence to show that the bison made themselves remarkably at home in such mountainous regions.

The writer spent most time in and along the eastern foot of the Teton Range, which forms the great west wall of Jackson Hole, but he discovered here no records of bison. It is extremely improbable that bison were ever able to get across the main portion of this range, one of the most formidable barriers to man and beast alike in the entire Rocky Mountain region; however, the animals may have found their way into Jackson Hole from the west as did John Colter, the first white man to invade these mountain fastnesses (in 1807), by going around the northern end of the range where the Tetons lose their ruggedness and pass under the lava flows of Yellowstone Park.

There is no reason to doubt that bison also worked their way southward into Jackson Hole from Yellowstone Park along the route of the Lewis River.

Yellowstone National Park

Regarding the occupation of Yellowstone National Park by bison the following communication (dated November 22, 1926) received by the writer from J. E. Haynes, official photographer of the park and well known authority on the region, is of interest:

> The skeleton of a bison was dug up in the yard of George Whittaker at Mammoth Hot Springs in 1924. It was buried in the travertine formation which being stratified indicates that the formation grew over the remains of the animal naturally. . . . . The U. S. Geological Survey contour map shows the elevation at this point to be 6260 feet. . . . . The depth at which it [the skeleton] was buried in travertine would indicate that it was there a long time as no active hot spring has been depositing travertine even near that location for considerably more than 45 years. In 1881 a picture was taken by F. Jay Haynes, my father, showing no hot spring activity in that neighborhood. Furthermore, travertine forming horizontally deposits relatively slowly. I mention these facts to show that the presence of the buffalo there antedated the slaughter on the plains during the 70's, therefore this particular bison probably belonged to, or came to this elevation—6260 feet—of his own free will.
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> In 1869 C. W. Cook in his Diary[6] . . . mentions the discovery of a buffalo skeleton in a spring now known as Buffalo Spring, at Lower Geyser Basin. I visited this last fall and found the spring did not disclose any visible remains of buffalo. This is at an elevation of 7,500 feet as close as I can determine the contour. . . . . Buffalo pool is not shown on the map but it is S. W. from the Great Fountain Geyser. Buffalo remains are yet visible in Buffalo Spring near

[6] Published serially in the Haynes Bulletin, issues for Dec., 1922, Jan., 1923, Feb., 1923, and May, 1923. See last page of issue for May, 1923.

Mound Geyser . . . . at an approximate elevation of 7,140 feet. In this pool there are yet visible several buffalo skeletons, which to my own knowledge have been there since 1881 (witnessed by my father that year).

MONTANA

Very few data are available concerning the subject of the former range of the bison in the Montana Rockies.

Vernon Bailey informs the writer (September 28, 1926) that in 1894 he found a "fairly complete and perfect skeleton of a very large bull buffalo on top of the Pryor Mountains in south central Montana."

The bones were apparently not very old and there were pieces of skin with the fur still clinging to the skull and some of the other parts of the carcass. They were scattered among the boulders and large rocks on the very summit of the range at about 9,000 feet well above timber line and where there were banks of perpetual snow. At that time I estimated that they may have been there fifteen or twenty years and that their fresh condition was due to the fact of their being buried under the snow for most of the year.

This is the only case that Mr. Bailey recalls of finding bison at high altitudes in Montana. He urges the importance of preserving before it is too late to do so any specimens of bison skulls found at such high altitudes, on account of the bearing they may have upon the validity of the mountain form supposed to have inhabited the Rocky Mountain region. The limited information available concerning the former occurrence of bison in the Glacier National Park region has already been published by Bailey.[7]

The writer is in receipt of a communication (dated October 7, 1926) from Dr. George Bird Grinnell on the subject, which states, in part:

I have frequently seen living bison at and above timberline, and have found their remains well above timberline in Montana and in Wyoming. The bison commonly ranged in and occupied the mountains, and even the high mountains, all through the year. Old hunters of the West recognized a difference between the buffalo that lived in the mountains and those down on the plains. Very likely this meant nothing more than the well known differences in color and in habits. In the mountains there were bison that commonly lived in the timber and went out into the open merely to feed. Actually these had often little opportunity to get into the sunshine, except when they climbed upon the bare mountain sides or above the timber.

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[7] Vernon Bailey. Wild Animals of Glacier National Park. Washington, 1918. Pp. 25–26.

CONCLUSION

By way of conclusion the writer wishes to suggest that the data presented in this and the preceding papers on the subject have, quite aside from their purely scientific interest, a practical significance in connection with a subject that has already engaged the attention of a few naturalists and that, in the opinion of the writer, must surely sooner or later come into greater prominence—the restoration of the bison as a *wild* animal to such portions of its former range as are still adapted to receive it.

The prospect of some day being able to observe *wild* bison under circumstances unmarred by fence or corral, of perhaps even restoring to a place among our game animals this noble creature, probably the most famous of American mammals, is an exceedingly fascinating one, in support of which strong public sentiment could doubtlessly be enlisted. Inevitably at some future time the practicability of doing in other localities something on the order of what has thus far been done with the bison only in Yellowstone Park and in Wood Bison Park, Canada, must come up for serious consideration.

It is now out of the question to turn bison loose on the plains. The only portions, if any, of the former range of the bison that could now possibly be restocked are certain uninhabited tracts in or adjacent to the mountains—within the national forests and national parks. Hence, obviously, the importance of preserving such scraps of information as can be obtained at this late period concerning the former range and life habits of the bison in our western mountains.

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MAMMALS OF A SMALL AREA ALONG THE MISSOURI RIVER

By Jean Linsdale

During the course of a detailed study of the birds of a limited area along the Missouri River in eastern Kansas, which was carried on between 1921 and 1925, the writer was given an opportunity to make definite observations on the habits and habitat preferences of the mammals of the area. The notes here presented were made, except where otherwise stated, within one mile of the old townsite of Geary, Doniphan County, Kansas.

The area of ground on which this study was made was divided into the following habitat divisions for convenience in analyzing the bird population: river, creek, lake, lake shore, Typha, slough, Salix-Populus, creek timber, bluff, timber edge, sprouts, orchard, roadside, pasture, cultivated field, yard, and buildings.

Didelphis virginiana virginiana. Opossum. The opossum was found commonly throughout the timbered parts of the area. Tracks were often seen at the edge of the water of the creeks and animals noted along roads after dark. Many were caught in traps, each winter, for their fur. The traps were usually set in holes in banks along the creek or on the bluff. On June 7, 1922, a dead female, which had been run over by an automobile, was found on a bridge over a creek. Some young that had been with the adult were still alive when it was found. A female was caught on December 2, 1922.

Scalopus aquaticus machrinoides. Missouri Valley Mole. Freshly made tunnels of the mole were found, at all times of the year when the ground was not frozen, on the bar, on the bluff, and in the fields. A dead mole was found along a road on June 6, 1922. On June 7, 1923, one came to the surface near a house and was captured. One was found dead in a path on the bluff on October 7, 1923.

On April 26, 1925, L. Whittaker, a farmer who lived two miles away from the area, reported that on April 24 a nest of four young moles had been found at the bottom of a post hole on his farm. The hole was about two feet deep. The nest was made of finely chewed material. The young were between three and four inches long.

Cryptotis parva. Little Short-tailed Shrew. Only two individuals of this species were caught on the area. A male was caught April 8, 1923, in a trap that was baited with bacon and set in a tunnel below the surface of the ground in a partially cleared space on top of the bluff, that had grown up with blackberries and other growths. On November 28, 1924, a female was caught in a trap that was baited with oatmeal and set in a runway in a weedy field near the top of the bluff.

Ninety-nine pairs of lower jaws of this animal were found in pellets of the short-eared owl that were picked up at one time on the bar south of the lake.

Blarina brevicauda brevicauda. Short-tailed Shrew. A female was caught

in a tunnel, just below the surface of the ground, in an old roadway half-way to the top of the bluff on June 17, 1922. Another female was taken in a similar runway under a brush pile on the side of the bluff on November 27, 1924. Six pairs of lower jaws of this species were in short-eared owl pellets that were found on the bar south of the lake.

Nycteris borealis borealis. RED BAT. Bats were seen flying nearly every evening in summer. They became especially numerous in the late part of the summer when more insects were flying at night. All that were collected belonged to this form.

On June 30, 1923, a male was found hanging on the under side of a leaf of sumac on the lower part of the bluff. On June 23, 1922, a female, with three young half-grown, was shot while hanging on the under side of a sycamore leaf in a tree near Doniphan Lake. The young were attached to the parent. One shot on June 16, 1922, was flying in circles about fifteen feet from the ground. One was found ten feet from the ground on a leaf in a redbud tree on the lower part of the bluff on July 2, 1923. A female that was shot on August 21, 1921, measured 110:46:9.

Procyon lotor lotor. RACCOON. Tracks of the raccoon were found, except in the colder parts of the year, at the edge of the water of the lake and along the creek. Skeletons of several dead raccoons were found on the lower part of the bluff near the lake and on the mud at the edge of the water.

On May 6, 1923, a nest containing young was found by S. G. Roundy. It was in a hole in the roots of a large walnut tree on the side of a ravine on the bluff. The parent was in the hole with the young. One of the little animals was removed and was injured so that it died. All the others were later removed by the parent. The dead one was seven inches long, its eyes were still closed, and there were traces of dark rings on its tail.

On June 3, 1923, an adult was startled, along the bluff near the lake. It ran through the leaves on the ground about fifty yards to a hole in the rocks that was about one foot in diameter and which showed evidence of recent use.

A medium-sized raccoon was found in a used crow's nest that was twenty feet from the ground in a willow tree on the bar on June 8, 1923. When the animal was punched out of the nest with a long pole it ran about ten feet up a small branch of the tree, where it clung for about ten minutes and then crawled back to the nest and curled up to resume its sleep.

A hen was taken from an old stove in a farmyard on the night of June 11, 1923, and tracks that led away indicated that it had been taken by a raccoon.

A young raccoon that weighed two pounds was found at the base of a vertical bank along the creek above the bridge on June 22, 1923. When first approached it gave a rattling scream. When it was approached more closely it raised itself upon its toes and barked sharply, and then turned and crawled behind a large, loose piece of dirt and attempted to hide. It was placed in a sack where it made no move and appeared to be little excited. Later it was placed in a cage and fed bread that was soaked in milk, which it ate readily. On June 24 the young raccoon pried the door of the cage open and escaped.

Several skins of this animal were taken in the area each winter by means of dogs and traps.

Mustela longicauda primulina. LONG-TAILED WEASEL. A weasel was seen

at seven o'clock in the morning of June 29, 1923. It was at the side of a road, near a hog shed where house mice were very abundant, and it may have come there to feed upon them. It ran into the weeds of a fence row and then was seen fifty yards away along the fence. Then, it jumped back into the weeds and was seen no more.

Mustela vison letifera. MINK. Mink tracks were seen, leading to a hole in the side of a muskrat house in the lake, January 12, 1924. The opening of the hole was about three inches in diameter and was above the level of the ice. The hole ran upwards and at least four feet into the house. A wing of a mallard was lying on the ice near the opening.

A mink was caught in a trap that was set under water in a slough on the E. V. Roundy place in the spring of 1924. Two were caught by trappers on the lake in the fall of 1924. They took them in traps that were set above the ice at the entrances to holes in muskrat houses. One was trapped on the lake during the last week in November, 1922.

On September 23, 1922, tracks of minks were seen on the mud at the edge of the lake. They led to and away from piles of duck feathers in several places.

Spilogale interrupta. PRAIRIE SPOTTED SKUNK. One was seen dead in a road on June 23, 1922. Another was caught in a trap that was set near a straw-pile about December 1, 1922.

Mephitis mesomelas varians. LONG-TAILED SKUNK. Skunks were frequently found in holes all over the area. In winter they were trapped and caught with dogs for their fur. One was seen walking along a road on June 3, 1923. On June 23, 1923, at six p.m., an adult female with five young was seen in a road at the lower edge of the bluff. The group went into a field of sudan grass at the side of the road. When they were approached closely the female left her young and started across the road, but she halted and returned to within ten reet of the intruder. Finally, she went into the weeds at the side of the road. The young, which were about one foot in length, ejected scent in a stream about three or four feet long. The adult was very thin.

On December 3, 1924, a narrow-striped skunk was seen at noon in a roadway at the edge of a patch of timber on top of the bluff. It started moving when disturbed and walked slowly in a half-circle to a den that was fifty yards away in the timber, where it went down one of the holes. Traps that were set there on the following day caught nothing.

Vulpes fulva. RED FOX. One that was dug out of a hole in the side of the bluff one mile south of the area in June, 1922, later escaped. Residents reported that this species was frequently seen.

Canis latrans. COYOTE. Coyotes were frequently heard howling on the bar and in the fields of the upland. It was reported that some dens that contained young were dug out on the bar soon after it was formed.

Marmota monax monax. WOODCHUCK. The woodchuck was common everywhere in the area. It did considerable damage to gardens and field crops. This animal caused the destruction of many small bridges by burrowing near them and causing washouts to start which grew until the bridge was carried away or had to be repaired.

One was seen out of its hole as early as January 25, 1923. In warm winters the animals were active throughout the winter. About the first of April of each

year all the occupied holes that were found appeared to have been recently cleaned or at least they had freshly dug dirt at their openings.

On May 18, 1924, a woodchuck was seen voluntarily and slowly walking across the creek at a place where the running water was about three inches deep.

On May 20, 1923, four young were found playing on the lower part of the bluff. Three of them ran slowly to a hole in the first ledge of rocks. The other "froze" near a large rock where it was shot.

An adult was seen clinging, four feet from the ground, on the side of a cottonwood eight inches in diameter that stood on the bar. The animal was in a fork made by a small limb. When approached to within four feet it jumped to the ground and ran about one hundred yards through the weeds in an irregular course until it became entangled and was killed. There were several pieces of shot in the skin of the head of this animal.

A young woodchuck was surprised while feeding at the edge of the timber near the top of the bluff on June 21, 1923. Still holding a leaf in its mouth, it ran up a small tree trunk seven inches in diameter and out on a limb six feet from the ground. Then it jumped to the ground and ran into the timber.

On July 3, 1923, a young woodchuck that was walking through the weeds on the lower part of the bluff stopped when three feet from me and stood still for about five minutes. Then it retraced its steps a few feet and came back in a circle to within five feet of me and began eating stems and leaves of some weeds. When a slight movement was made the animal ran off through the weeds.

While I was sitting still and watching some birds on September 12, 1925, a woodchuck approached through the timber on the lower part of the bluff, walked to an upright oak tree about ten inches in diameter, and without hurrying climbed straight up the trunk about twelve feet where it clung for a few seconds. Then it backed down the trunk for about six feet and after a short pause turned and crawled head first down the trunk and walked rapidly away through the timber, but not as though frightened. It did not appear to notice me at any time.

Dogs frequently found woodchucks away from their holes and killed them. When two dogs hunted together they were nearly always able to kill any woodchuck that they might find.

Citellus franklinii. FRANKLIN'S GROUND SQUIRREL. Reported to occur in small pastures and fields on the upland back of the bluffs.

Citellus tridecemlineatus badius. THIRTEEN-LINED GROUND SQUIRREL. This species was common in the fields and pastures of the farms in the upland.

Tamias striatus griseus. GRAY CHIPMUNK. Seven individuals of this species were found in this area during this work. The animal was usually seen running over logs, rocks, or stumps on the bluff and especially in the ravines and lower portions of the bluff. One was seen seven feet from the ground in an oak tree on June 4, 1923. A male was shot on the lower part of the bluff on October 12, 1924. The earliest record for one active in the spring was March 25, 1925.

Sciurus carolinensis carolinensis. GRAY SQUIRREL. A few gray squirrels were resident in the area. They were usually seen in medium-sized trees on the bluff.

Sciurus niger rufiventer. WESTERN FOX SQUIRREL. Fox squirrels were resident in all parts of the area that were covered with timber. They lived in holes in the trees and in nests that were built in the open. On sunshiny days in the winter they were frequently seen sunning themselves on the limbs of trees.

Mating activity was noted on March 29, 1924. On April 20, 1924, a young squirrel about seven inches long was taken from a nest in a willow tree on the bar. Workmen took several other young from nests on the bar during the week before this. A young squirrel, about one-third grown, was seen in the top of a small tree along a road on May 12, 1923. A squirrel was seen walking slowly across the creek at a place where the water was three inches deep on May 20, 1923. Squirrels did some damage to crops in the fall by carrying off corn. A pair was killed by a dog on the bluff on November 27, 1924.

Glaucomys volans volans. SMALL EASTERN FLYING SQUIRREL. Three flying squirrels were taken from a nest in a hollow redbud in a ravine on a farm one mile from the river on March 8, 1925. The nest was two feet below the top of the hollow, which opened four feet from the ground. The three animals ran into a sack that was held over the opening. Later two of them escaped, and the third was made into a study skin. A flying squirrel was killed in a shed in Doniphan in May, 1924.

Geomys bursarius. POCKET GOPHER. Pocket gophers were common in the fields throughout the area. They were most active just before the ground was frozen in the fall. A few were found in small clearings on the bluff. On July 2, 1923, a gopher was pulling stalks of sweet clover into a hole and was cutting them into pieces about two inches long. This was at 4:30 p.m.

Reithrodontomys megalotis dychei. PRAIRIE HARVEST MOUSE. A female was caught on January 25, 1923, in a trap that was baited with oatmeal and set in a path in the willows on the bar. Another female that was running in a weedy field on top of the bluff on November 26, 1924, was caught on the ground in the afternoon. It contained five embryos. A male was caught December 2, 1922, in a trap that was set in a runway in which a specimen of *Microtus* had been caught. Another male was caught in a runway through blue grass in a fence row around a pasture on December 14, 1924.

Peromyscus maniculatus bairdii. PRAIRIE DEER MOUSE. A male was caught in a corn shock on December 1, 1924, and another on December 14, 1924, in blue grass along a fence row at the edge of a pasture.

Peromyscus leucopus noveboracensis. NORTHEASTERN DEER MOUSE. This species was caught in traps that were set in the timber on the bluff, on the bar, and in the fields near the timber. Some were taken each winter in corn shocks near the timber.

On February 3, 1924, a female about half-grown was caught in the willows on the bar. It contained four embryos each about three millimeters long. On February 22, 1924, five females were caught that had four embryos each and and one was taken that contained no embryos. All these were trapped with raisin bait in corn shocks. A female that was caught on April 6, 1925, contained four young embryos.

A mouse about one-third-grown was found in a red-winged blackbird's nest one and one-half feet from the ground in weeds south of the lake on June 27, 1923. On July 1, 1923, a male was found in a hole in a stump in which a pair of bluebirds had nested earlier in the season.

Microtus ochrogaster. PRAIRIE VOLE. Colonies of the prairie vole were found in fields and waste ground where the cover of grass and weeds was sufficiently dense to furnish protection for them. Each set of runways was deserted after a few months' use.

In winter this animal went to the shocks of corn and other grain, and lived until spring. There it fed chiefly upon the grain. When traps were set in these shocks the animals that were caught were nearly always eaten up and sometimes even the wooden traps were chewed and partly eaten. This behavior may indicate that some important element in the food of this animal was lacking in the winter diet in the corn shocks.

Two that were about one-third grown were caught in corn shocks on April 8, 1923. A female with young was plowed out of a field on June 16, 1922. Two that were about half-grown were caught on the bar on December 2, 1922.

Pitymys nemoralis. WOODLAND VOLE. On February 22, 1924, a male, a female without embryos, a female with two small embryos and a female with three small embryos were trapped in corn shocks near timber on the bluff.

On February 15, 1925, a colony of this species was found in a clearing above a road on the bluff. There were many runways at and below the surface of the ground. There were some bushes and weeds on the ground but the covering was not thick. Thirteen were caught in fifteen traps that were set for two nights. On March 9, 1925, a male and two females were caught in the same runway. One female had two embryos, each eight millimeters long, and the other had two that were each thirty-one millimeters long. Two were caught in tunnels that were below the surface on the lower part of the bluff on April 8, 1923. Another female was taken in a nest in a corn shock. Three suckling young were clinging to this animal. Several were trapped in corn shocks on November 27, 28, and 29, 1924. One was taken in a thick growth of blue grass at the head of a ravine on December 14, 1924.

Ondatra zibethica zibethica. MUSKRAT. On January 12, 1924, there were about two dozen houses of the muskrat in the lake. Some of the clearings around the houses were as much as twenty yards in diameter. The weeds had been cut from one to two inches above the surface of the water. Some of the houses were made out of *Nelumbo*, some of *Polygonum*, some of *Typha*, and some were of mixed kinds of material. The animals appeared to use whatever material was near at hand. Two or three of the houses were built around fence posts and one was at the end of a large log. Some were large and some were small. Not any of the snow on top of them had melted.

In January of 1925, a trapper said that he had counted thirty-five "nest houses" in the lake and that each one of them had an average of five individuals. He caught one hundred and fifty and others caught fifty so that the total catch for the season was about two hundred. There were many other "feed houses," which were smaller. He caught two minks in holes in the houses during the winter.

A muskrat was seen swimming in water in the creek on January 25, 1925. It was in water that was flowing one foot deep over old ice in the creek. The animal dived when it was disturbed. On March 1, 1924, a muskrat was digging a hole in the bank of the fish pond in the E. V. Roundy yard. A male was trapped along the creek on December 1, 1922. Its tail was short and apparently had been frozen.

Rattus norvegicus. BROWN RAT. The rat was a common pest in the vicinity of farm buildings and granaries. It was especially numerous in feed lots where corn was thrown out on the ground for stock.

Mus musculus musculus. House Mouse. House mice were abundant in and around all farm buildings and in addition they spread to the fields surrounding the buildings. This was the first mammal to invade the shocks of corn and other grain in the fall and was probably the most abundant and did the most damage there.

Zapus hudsonius hudsonius. Jumping Mouse. An individual that was a little more than half-grown was caught in a trap set in a road through the willows on the bar on June 23, 1922.

Lepus californicus melanotis. Great Plains Jack Rabbit. Jack rabbits were seen on four occasions during the work in this area. Most of them were in fields on the upland. On June 7, 1923, one was seen on the mud flat near Doniphan Lake.

Sylvilagus floridanus mearnsii. Mearns' Cottontail. Rabbits were common over all the area where there was enough cover to furnish protection. They stripped shrubs and small trees as far from the ground as they could reach.

Several young that were able to run around were seen on April 19, 1924. On April 25, 1925, a nest with six young was found among the rocks on the lower part on the bluff near the lake. The young were about four inches long. No parent was seen but a large bull snake blocked the opening of the nest and was at the same time swallowing one of the young and preventing the escape of the others. As soon as the snake was pulled away from the nest the little rabbits scrambled out of it and over the rocks in all directions. The nest was made of fur.

On April 19, 1923, one was caught that was about six inches long, and another that was about four inches long and was much less developed was brought in as food for kittens by a mother cat. Young rabbits furnished the larger part of the food of cats and their broods of young in the spring and summer. Empty nests were found in the last week of April and the first week of May, 1923. On June 3, 1923, several young about one-third grown were seen.

The number of rabbits present on the area at one time varied greatly during the period of this study. In some seasons large numbers would be found in one day, while in other seasons a day's work might be done on the same ground without seeing a single individual. Several species of predatory birds and mammals obtained a large part of their food by capturing rabbits.

Berkeley, California.

A NEW FORM OF MUS FROM HOKKAIDO

By Nagamichi Kuroda, M.A.S.M.

I take this opportunity to describe the following apparently new form of *Mus* from Hokkaido:

Mus molossinus yesonis subsp. nov.

Type.—Adult female in summer pelage, from Uinai, Prov. Iburi, Hokkaido; October 5, 1925. N. Kuroda collection, no. 1097. H. Orii collector.

Diagnosis.—Resembles *Mus molossinus molossinus* from Hondo, Japan, but differs from it in having the upper parts decidedly darker with less brownish wash; underparts dark mouse gray (in summer pelage) or grayish white (in winter pelage and young) instead of pale yellowish white as in *molossinus;* underside of tail being darker (brownish) and not white; hind foot a trifle longer reaching to 17 mm. in length.

Skull.—Exactly similar to typical *molossinus.*

Measurements of the twelve specimens examined

NUMBER	SEX	LOCALITY	HEAD AND BODY	TAIL	HIND FOOT	EAR
			mm.	*mm.*	*mm.*	*mm.*
108	♂ juv.	Uinai, Iburi	65	51	15	11
684	♀ juv.	Near Hakodate	65	51	14.5	11.5
685	♂ juv.	Near Hakodate	57	54	17	12
Type, 1097	♀ ad.	Uinai, Iburi	78	70	14	12
1139	♀ ad.	Uinai, Iburi	71	63	17	12
1140	♂ ad.	Uinai, Iburi	70	64	17	12.5
1141	♂ juv.	Uinai, Iburi	72	54	15.5	11
1309	♀ ad.	Uinai, Iburi	76	51	15	12.5
1310	♂ vixad.	Uinai, Iburi	78	53	15	12
1311	♂ vixad.	Uinai, Iburi	73	53	14	12
1312	♂ vixad.	Uinai, Iburi	73	50	16	12
1313	♀ ad.	Uinai, Iburi	74	56	15	12

Fukuyoshi Cho, Akasaka, Tokyo, Japan.

GENERAL NOTES

A FLORIDA RECORD OF SOREX LONGIROSTRIS

Apparently the only record of *Sorex longirostris longirostris* Bachman for Florida is an adult male collected by the author May 30, 1927, in a swamp five miles east of Gainesville, Florida. It was trapped not far from the edge of the swamp at the base of a sour gum tree. At this time the swamp was rather dry, but during rainy periods water often stands in the low places for considerable time. The stomach of the shrew was found to contain yellow corn meal, with which the trap was baited, and a small amount of other material not identified. I am indebted to Dr. H. H. T. Jackson for verifying the identification of this specimen.—HARLEY B. SHERMAN, *University of Florida, Gainesville, Florida.*

AN EXTRA MOLAR IN THE EASTERN HEDGEHOG, ERINACEUS ROUMANICUS

A very interesting hedgehog (*Erinaceus roumanicus* Barrett-Hamilton) came from Halimba of the county of Veszprém to the collection of the Hungarian

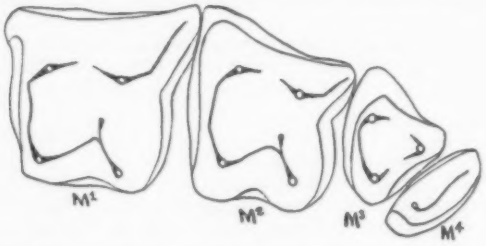

FIG. 1. UPPER MOLARS OF ERINACEUS ROUMANICUS. THIRD MOLAR SUPERNUMERARY. DIAGRAMMATIC, GREATLY ENLARGED

National Museum. In its upper mandible there is an extra molar on each side, well developed and well fixed in the jaw. The tooth formula of the hedgehog as generally in use and well proved is $\frac{123.\ 1.\ 234567*}{12.\ 1.\ 34567}$.

The additional molar on the Halimba skull is to be considered an atavistic feature, and its existence may be explained in the following way:

The Insectivora are comparatively near the Marsupialia, so that it is not excluded that the fourth molar characteristic of the latter class is an atavistic mark on the *Erinaceus*. If we compare the teeth of this abnormal *Erinaceus* with those of a regular hedgehog, it is instantly obvious that this additional molar is wedged between the last and last but one molar. The shape of the additional molar is triangular, it has three points and three roots, and therefore is very similar to the third molar of *Gymnura*, a near relative of *Erina-*

* Winge, Herluf. Udsigt over insektaedernes indbyrdes Slaegtskab. Vidensk. Medd. fra Dansk Naturhist. Foreningen., Bd. 68, p. 199, 1911.

ceus, having the most complete set of teeth among the Insectivora. The last molar (in the present case m^4), notwithstanding its bent roots and compressed state, is entirely similar to the usual last molar of the hedgehogs. I have to remark, by the way, that the last, narrow, two-pointed and two-rooted molar of the *Erinacei* is very similar to the last (fourth) molar of *Dasyurus* among the Marsupialia. In other words, if we compare the additional tooth either with *Gymnura*, or with the teeth of other hedgehogs, we necessarily come to the conclusion that, in the case of the *Erinaceus*, m^3 did not disappear entirely, and m^4 remained the last molar. This seems to be proved also by its similar character with the fourth molar of *Dasyurus*. If we accept this hypothesis, the correct tooth formula would be $\frac{123.\ 1.\ 234568}{12.\ 1.\ 34567}$.

It is not my object in this case to discuss the correctness or incorrectness of this hypothesis. I simply wanted to point out the possibility of an interesting hypothesis. I may mention furthermore that W. K. Gregory, in treating the descent of the Insectivora in his great study on the mammalian orders, enumerates eleven marsupial characters of that order, the occurrence of the upper fourth molar being the sixth of them, which occurs exceptionally in his opinion in *Cententes*.[1] In the same place Gregory says: "The order Insectivora is structurally nearer to the Marsupio-Placental stem than is any other existing placental order." The above observation is to serve as an additional proof of Gregory's observations.—Julius Éhik, *Hungarian National Museum, Budapest, Hungary.*

PILOT BLACK-SNAKE FEEDING ON THE BIG BROWN BAT

While investigating a bat roost in the attic above a two-story frame farmhouse near Jessup, Maryland, on June 28, 1927, I captured a 38-inch pilot blacksnake (*Elaphe obsoleta obsoleta*) within the boxed-in eaves just under the projecting metal roof. This space is the roosting place of numerous big brown bats (*Eptesicus fuscus fuscus*). Two of these bats were later identified from the stomach contents of the captured snake, by Remington Kellogg, of the U. S. Biological Survey.

It is worthy of note that this same roost was visited in August, 1926, at which time sixty-eight bats were counted as they flew out after being disturbed, and the population of the roost at that time was estimated at one hundred bats. On June 28, 1927, considerably less than half that number were present. At least four shed snake skins were found, which would indicate that this snake, or possibly others, had occupied the premises for more than the present season, and may have been responsible for the decrease in the number of bats in the roost.—James Silver, *U. S. Biological Survey, Washington, D. C.*

NOTES ON THE TIME OF BREEDING AND THE NUMBER OF YOUNG OF CYNOMYS LUDOVICIANUS

Dr. George E. Johnson's recent article in the Journal of Mammalogy (May, 1927) on young prairie dogs born in the laboratory caused me to look up some

[1] Gregory, W. K. The Orders of Mammals, Bull. Amer. Mus. Nat. Hist., vol. 27, p. 286, 1917.

data that I had collected on this species over a period of three years, 1921 to 1923. I had begun this study to get more definite information on the life history of the prairie dog, but the investigation was interrupted by my subsequent removal to a state east of the prairie-dog inhabited regions.

Some of these observations seem worthy of recording at this time since they were made in greater part in territory in Kansas immediately south of where Doctor Johnson reports from and they tend to support his conclusions relative to the time the young are born.

My records are of females examined during the months of February and March and that were collected following poisoning operations in heavily infested areas. The first one is from Oklahoma and only has a bearing on the number of young common to the species. Unfortunately I did not take an exact count of the number of females examined on that occasion. My notes say: "More than a dozen females were opened and counts made of the embryos." In this record the embryos varied from four to seven for each female. A majority of the embryos were quite far advanced in development, apparently being near

TABLE 1

DATE	LOCATION (COUNTY)	NUMBER EXAMINED	NUMBER PREGNANT	NUMBER OF FEMALES WITH THE FOLLOWING NUMBER OF EMBRYOS								
				2	3	4	5	6	7	8	9	10
February 16, 1923.....	Sumner	28	11				1	4	1	2	1	1*
March 17, 1922.....	Sedgwick	26	25	2	2	6	10	3			1	†
March 22, 1922.....	Marion	14	14		4	4	5	1				

* One female was partially destroyed by crows, only one embryo left.

† One pregnant female lost before count was made.

time of birth. The date was March 4, 1921; location, Wichita National Forest, Comanche County, Oklahoma.

The records given in table 1 are from three Kansas counties south of Manhattan, one (Sumner) being on the Oklahoma line.

The number of embryos recorded in these different counts varied from two to ten. No instance of less than two embryos was noted. It may also be of interest to include the observation that both horns of the uterus always contained embryos, as no case was observed of all embryos being on one side only. Since only two cases each of eight and nine, and one case each of seven and ten, were seen, the occurrence of litters so large is probably unusual in this species. As will be observed on the basis of these counts the average-sized litter is 5.02 young.

In the region of southern Kansas (Sumner County) the rutting season must begin early in February (young embryos noted February 16), and young may be born before the middle of March, assuming that the period of gestation is at least as long as in the closely related genus *Citellus*. In this group the time is definitely known for two species, *Citellus columbianus*, for which 24 days is recorded by Shaw, and *C. tridecemlineatus* for which a lunar month is given

by Wade. The season of activity in this region is usually some two weeks earlier than one hundred miles farther north.

In Marion County, the northernmost point included in this record, the condition of certain fetuses on March 22 indicated that parturition would occur within a very few days. It is probable that some young had already been born although no females were taken that were suckling young.

Those examined in Sedgwick County on March 17 showed a great variation in the development of the embryos. Some were quite young, scarcely larger than a garden pea, while a number were almost fully developed.

Compared with the above, those counted on February 16 in Sumner County were all young, the most advanced ones in growth probably being less than one-third developed. Also thirteen females, or more than half the number examined, showed no traces of embryos at that time. Four females were so badly damaged by crows that it was impossible to determine their condition.—Otis Wade, *University of Nebraska, Lincoln, Nebraska.*

PINE SQUIRREL CARRYING YOUNG

The following observations were made near Fox Park, about forty miles west of Laramie, Wyoming, on July 10, 1925. They seem worth noting in that they corroborate certain observations incorporated in Herbert Lang's paper published in the Journal of Mammalogy, February, 1925, but with a different species. The species here considered is presumed to be *Sciurus hudsonicus baileyi* (Allen).

While setting road survey stakes in a rather open stand of lodgepole pine my companion (James P. Reddick, U. S. Forest Service, Denver, Colorado) and I noticed a "pine squirrel" which seemed unduly excited. A few moments later it became evident that the animal was transporting youngsters from a pile of chips between our stakes, and over which we had undoubtedly walked. We then quietly watched its activity.

The squirrel (its sex, of course, was not determined, but it was assumed to be a female), ran upon a log three or four feet from us, disappeared in the chips and came forth with a youngster in "her" mouth. When she had progressed but a few feet she paused, placed the baby upon the ground and re-adjusted her burden, using the fore paws and mouth to do this. When she again made off, the youngster's hind feet stuck up along the right side of her neck. I do not believe the young squirrel's tail was over the old one's neck, but that it rather was close to the youngster's body and under the old squirrel's chin. The baby's head and fore paws were in a position corresponding to that of the hind feet, but on the opposite side of the parent's neck.

While she arranged the little fellow on the ground, I saw the squirrel once seize the youngster by the small of the back; but when actually transporting it, I believe her grasp was on its left "side," scarcely low enough on the body to be truly ventral.

We saw two such trips made. In both cases the young squirrel was carried up into a fair-sized lodgepole stub, which appeared to have been demolished by lightning. I am of the opinion that other young had been carried away before we were aware of it.

The nest in the chip pile was placed between some branches over which the hewn chips of "tie hewers" had accumulated. It appeared to be made of dried grasses, was roofed-over, and was approximately seven inches in diameter. A short runway, about a foot long, led under the chips to the nest.—WALLACE B. GRANGE, *Ladysmith, Wisconsin.*

AN UNUSUAL ABUNDANCE OF BANGS' POCKET MICE IN LA PUERTA VALLEY, CALIFORNIA

Bangs' pocket mouse (*Perognathus longimembris bangsi*) according to Frank Stephens (Trans. San Diego Soc. Nat. Hist., vol. 3, no. 3, p. 48, 1921) is "not common" in San Diego County, California. In conversation, Mr. Stephens has told me that he can seldom catch more than one or two of these mice in a week or so collecting on his ranch at La Puerta, in eastern San Diego County. My own experience on visits to Mr. Stephens' ranch during December, 1925, and December, 1926, was even less successful, for I was unable to capture a single specimen. By way of contrast, it is worthy of record that at the same place between April 6 and 19, 1927, I trapped 64 specimens of this form. In his book, "California Mammals" (San Diego, 1906, p. 164), Mr. Stephens writes of the closely related short-nosed pocket mouse (*Perognathus longimembris brevinasus*) as "occasionally common locally after wet seasons, but usually rare." Perhaps in a similar way, the wet winter of 1926–1927 in southern California was responsible for the unprecedented abundance of *P. l. bangsi* at La Puerta. However, in two days collecting there on May 28 and 29, 1927, I was able to procure but one specimen.—JACK C. VON BLOEKER, *San Diego Society of Natural History, San Diego, California.*

THE FLORIDA WOOD RAT IN SOUTH CAROLINA

The following note on the Florida wood rat, *Neotoma f. floridana* (Ord), in South Carolina may be of interest in view of the fact that the distributional map of this species, appearing in North American Fauna no. 31 (1910), includes only the southeastern corner of the state, adjacent to the mouth of the Savannah River, and extending north along the coast as far as Frogmore, on St. Helena Island.

During the spring of 1926 I collected seven specimens of this species from nests located in a small, swampy area near Goose Creek (Otranto Station), eighteen miles inland from Charleston, South Carolina. The precise locality is a wooded, tangled, swampy bottom covering possibly two acres. Here were found eight to ten nests about two feet in height and three feet in diameter, placed on the ground or up to a height of fifteen feet. The nests were in tangles of grape and smilax vines. Of the wood rats collected, three were nursing young that clung to the teats of the mother when she ran out of the nest. One of the young was killed when the mother was shot (April 29, 1926) and the other two died after two or three days, though an attempt was made to feed them with a dropper, as well as by placing milk in a saucer. These young, all males, averaged 198 mm. in length, with an average tail measurement of 76.33 mm. On the same date on which this female and young were taken I also saw three young, probably three weeks older than those taken, run out of a nest near the ground and dis-

appear in a tangle of briars. All the nests were composed of sticks (from thumb-size down), grass, dead leaves, and rubbish. Most of the nests had a handful or more of fresh leaves in the interior, and in one about two-thirds of a weathered plastron of a six-inch mud turtle was noted.

In late January of last year (1927) I revisited the above locality and noticed that the ground nests had been destroyed by fire and that apparently only three of the nests in the vines were in use. I also noted that a nest from which I took a large male contained a number of feathers of the song sparrow, *Melospiza melodia*.

Of the eight rats collected from the above locality, two are adult males, one adult female, one sub-adult male and one sub-adult female, and the remaining three nursing young, all males. I have noticed that I have taken males from certain nests on different occasions, and females or young from other nests, but never the two sexes from the same nests, not even at different times.

In February I found a large ground nest, apparently empty, in the hollow base of a large oak on Prospect Hill Plantation on the South Edisto River, thirty-five miles southeast of Charleston. No one in the vicinity seemed to know the species. Later, in March (1927), Herbert L. Stoddard of the U. S. Biological Survey mentioned to me that he had lately seen a nest of this species on one of the plantations up the Cooper River, probably thirty miles inland from Charleston.

Audubon and Bachman, in "Quadrupeds of North America," refer to South Carolina a number of times in writing of this animal, but they give no definite localities, though stating that it is very abundant in the state. This I have not found to be the case, although I have not worked the territory about the mouth of the Savannah River. In fact this species seems to be rather locally distributed, usually in small colonies.

I have seen no records of the occurrence of this wood rat north of Frogmore, South Carolina, and so far as I know the instances cited above extend the range of the species by forty-five to fifty miles north along the South Carolina coast.

The specimens mentioned as collected are in the Charleston Museum.—E. B. Chamberlain, *Charleston Museum, Charleston, South Carolina.*

THE FOOD AND HABITAT PREFERENCES OF PHENACOMYS ALBIPES

Perhaps the majority of us who have collected extensively have, by a special sequence of circumstances, encountered with more than our fair share of frequency some one mammal which belongs in the list of decided rarities. In such we may be pardoned an absorbing interest and a delusion that it is of equal concern to others.

In the above category belongs the little *Phenacomys albipes*, for it has been my fortune to secure more than my full share of them—due to luck, augmented but feebly by any undue perseverance. I trapped seven of this species near Trinidad, Humboldt County, California, from July 23 to 29, 1926. They were all taken in one little gulch densely shaded with (mostly) redwood, bay and maple trees and about a half-mile from the sea.

If I am not mistaken there are now on record fifteen specimens of this *Phenacomys*. The nine which I have procured and at least two of the remainder have been caught in identically the same type of habitat, this being a gravelly bar

at the margin of a little forest stream of the humid coast belt, and either beneath or close to a network of flood-exposed tree roots.

Why this association? They do not come here merely to drink, for they would then preferably seek the innumerable and presumably more accessible trickles and seepages of the gulch sides and would be caught in the traps that have been set in such situations by the hundreds. It is unlikely that they are even as aquatic as most members of the Microtinae, and they exhibit no signs of fossorial specialization.

Three full stomachs were saved and submitted to the division of food habits research, U. S. Biological Survey. According to C. C. Sperry these each contained 100 per cent of finely triturated roots of some herbaceous plant. Mr. Sperry informs me that there is no doubt of the *underground* part of the plant having been consumed. With verdure of bewildering variety all about, why would a microtinid wish to dig up and eat only the roots of this plant? We then have a forest rodent with presumably limited food predilections, consisting of roots, but which is indicated as frequenting for at least eleven-fifteenths of its periods of activity the little sand-bars that border the streams of its vicinity.—A. Brazier Howell, *National Museum, Washington, D. C.*

UTAH RECORD FOR ZAPUS PRINCEPS PRINCEPS

I have been unable to find any published record of *Zapus princeps princeps* for Utah. On June 10, 1925, I procured near Pine Crest Inn, Salt Lake County, Utah, an adult male of this form. It was taken a few feet back from a small stream at an altitude of about 9000 feet. The specimen has been identified by Dr. J. Grinnell at the Museum of Vertebrate Zoology, Berkeley, California, and is at present in my collection.—L. R. Wolfe, *U. S. Army, Fort Douglas, Utah.*

ZAPUS PRINCEPS PRINCEPS IN UTAH

A specimen of *Zapus princeps princeps* was taken by the writer five miles south of the Mammoth ranger station, at an elevation of about 9500 feet, Manti National Forest, Utah, July 2, 1927. On July 30, 1927, another specimen was taken about five miles north of the first record and at an elevation of about 8500 feet. Seven specimens were obtained in the vicinity of Mount Baldy ranger station on the same forest during the first part of September, 1927. They were obtained at an elevation of 9600 feet, about thirty miles south of the first record and on the same mountain range. O. J. Murie found them common in the vicinity of the Great Basin Experiment Station during September, 1927. The station is at an intermediate point on the same mountain range and at the same approximate elevation.

Examination of the September specimens showed them to be quite fat, indicating that they hibernate at this elevation. Stomach contents of six of the seven specimens consisted entirely of a white, starchy, glutinous paste. Contents of the seventh stomach showed traces of a brown seed coat. The main seed eaten appeared to be that of an introduced brome-grass that grew vigorously in the station yard. Runways were quite plain, and were strewed with pieces of this grass cut in lengths of about four inches. No *Microtus* were taken in

these runs although *Peromyscus* were common.—A. W. Moore, *Biological Survey, Salt Lake City, Utah.*

TWO NEW RECORDS FOR OHIO

Arthur B. Fuller, of the Cleveland Museum of Natural History, took a single specimen of the woodland jumping mouse, *Napaeozapus insignis*, at Mentor, Lake County, Ohio, August 30, 1925. The specimen is preserved as an alcoholic, so no subspecific determination was made. It is preserved in the Cleveland Museum.

Another new record for Ohio is *Evotomys gapperi* taken at Farnham, Ashtabula County, June 22, 1927, by the writer. The single specimen, a young male, is preserved as a study skin and skull and is in the Museum of Zoology, University of Michigan.—Robert K. Enders, *Union College, Schenectady, New York.*

MAMMALS OF UPPER SOUTH CAROLINA

South Carolina is unique among all the states of the southern Atlantic slope in that it sends no stream whatever into the rivers that empty into the Gulf of Mexico, and any species recorded from this state can be put down as ranging into the Atlantic slope. Only one county boundary, that of Greenville, meets with the edge of the Mississippi basin, merely touching the dividing ridge, and for that reason when a species is recorded as ranging south from, say, Pennsylvania to Georgia, it is doubtful whether it occurs in the most southern of the Carolinas, which is thrust like a wedge between North Carolina and Georgia, the mountains of which meet for many miles west of the intermediate state. I set about some time ago obtaining data as to the mammals found in the hill and mountain section of the state, including the territory northwest of the fall-line running from Augusta, Georgia, through Columbia, Camden, and Cheraw to the North Carolina line. This is "upper South Carolina."

The common opossum (*Didelphis virginiana*) and the common mole (*Scalopus aquaticus howelli*) are, of course, both common. Of the rather less familiar shrews, the Carolina shrew (*Blarina brevicauda carolinensis*) was taken by John Barratt, of Abbeville County, for Doctor Bachman, and I secured another in Greenville during the summer of 1924, my specimen being identified by Gerrit S. Miller, Jr. In my collection is an ash-colored shrew (*Cryptotis parva*) taken in a meadow inside Greenville city, February 19, 1927.

Among the bats I list the little brown bat (*Myotis lucifugus*), yellowish bat (*Pipistrellus subflavus*), big brown bat (*Eptesicus fuscus*), and northern red bat (*Nycteris borealis*) as most common, though other species may be expected at intervals.

The chipmunk (*Tamias striatus*), the gray squirrel (*Sciurus carolinensis*), and the flying squirrel (*Glaucomys volans*) are holding their own against civilization with splendid adaptability. The fox squirrel (*Sciurus niger*) is entirely extinct in even fairly populous sections, and has been driven to the denser forests long since, but rare examples may still be expected near the fall-line. The woodchuck (*Marmota monax*) is only rarely seen away from the high mountain slopes, but one specimen not long since strayed to a neighboring garage, here in Greenville, and built a nest. It was possibly an escaped pet, as I have never seen

another at liberty so far from the mountains. The house mouse (*Mus musculus*), black rat (*Rattus rattus*), and brown rat (*Rattus norvegicus*), we could, of course, not avoid, but I have no convincing records of the roof rat. Among wild cousins of these, Doctor Barratt has recorded the little harvest mouse (*Reithrodontomys humulis*) in the Abbeville and Greenwood regions, evidently. The common deer mouse (*Peromyscus leucopus noveboracensis*) is common in the upper Piedmont and alpine regions, but the golden mouse (*Peromyscus nuttalli aureolus*) appears to be more common around Troy in Greenwood County, where I collected a specimen and nest about nine years ago which I placed in a local collection in care of Prof. G. A. Buist. I have seen this species in the mountains a single time. The cotton rat (*Sigmodon hispidus*), usually regarded as an Austroriparian form, is very common, and at Greenville I took specimens in traps, February 26, 1927, two being now in my collection. It also appears in the upper Savannah valley. The Appalachians are in plain view from both points. The Pennsylvania wood rat (*Neotoma pennsylvanica*) I have found evidences of well to the south of the state boundary among the Saluda Mountains, and near Little Rich Mountain, near the dividing ridge between the Atlantic and the Mississippi tributaries, 1926. The pine mouse (*Pitymys pinetorum*), our southern short-tailed mouse, is generally distributed. Though rarely seen on account of its nocturnal habits, the muskrat (*Ondatra zibethica*) holds its own pretty well, and I have two or three records from within the city limits of Greenville. The cottontail (*Sylvilagus floridanus mallurus*) is the only rabbit I can record with certainty.

The bobcat (*Lynx rufus*) is fairly common in the mountains. I was surprised a few months ago to find that Dr. David Smith had just mounted the head of a gray wolf (*Canis lycaon?*) caught in a steel trap by a student of Six Mile Academy. I am wondering if this individual may not have escaped from captivity. The red fox (*Vulpes fulva*) and the gray fox (*Urocyon cinereoargenteus*) occur locally, and in some places have been introduced again. The common weasel (*Mustela noveboracensis notia*) and its relative the mink (*Mustela vison mink*) are both found in the higher Piedmont. The southern skunk (*Mephitis elongata*) is apparently being driven into the more wooded localities, but the little spotted skunk (*Spilogale putorius*) holds on wonderfully well. One otter (*Lutra canadensis lataxina*) I record from Three-and-Twenty Valley. This specimen was shot and skinned during the later nineties by R. M. Pickens. The raccoon (*Procyon lotor*) is not uncommon in larger forests. The black bear (*Euarctos americanus*) appears to be represented only by strays from North Carolina and by escaped captives. Probably the same might be said of the Virginia deer (*Odocoileus virginianus*).

Bachman has recorded the red squirrel (*Sciurus hudsonicus*) at a nearby North Carolina point, and L. M. Loomis, the noted ornithologist, thought it probably present on the Big Eastatoe, about forty years ago. His conjecture as to the presence of the Canada lynx (*Lynx canadensis*) is not so probable.

Fishes, amphibians, reptiles and birds of upper South Carolina have all received careful attention from professional and amateur naturalists, which makes the neglect of the mammals of this region all the more conspicuous. It is to be hoped that the recent hegira of campers and tourists to the Carolina highlands will bring observers who will give the highest class of vertebrates full dues in

friendly interest, perhaps adding yet others to the above list. Interesting problems are involved. Bachman, for instance, records the star-nosed mole near the South Carolina border in the North Carolina mountains; Burnett says he observed it at Aiken just below the fall-line, the southern boundary of the Piedmont (Proc. Boston Soc. Nat. Hist., vol. 4, p. 115). Is this water-loving animal unable to survive in the region between these two points on account of the narrow steep valleys, and the occasional drought, or is it that carelessness and neglect of mammal study have failed to record it?—A. L. PICKENS, *Greenville, South Carolina.*

RECENT LITERATURE

Ashbrook, Frank G. FUR-FARMING FOR PROFIT. New York: The Macmillan Company. 8vo, pp. xxiii + 300, text figs. 127, mostly halftones. Cloth, $4.00. March 27, 1928.

Several books and pamphlets relating to the fur-farming industry have been published, but these have been either of local application or devoted to some particular species of fur-bearer or some special phase of the subject. Many of these publications were issued by fur-farmers or dealers with the idea of selling stock. Some of them contained valuable information. The present volume, however, constitutes the only broad and comprehensive treatment of the field from an unbiased viewpoint. The author, as chief of the Division of Fur Resources, U. S. Biological Survey, has had close personal contact with the industry, and is a recognized authority on the subject.

The introductory chapters of the book deal with such generalities as nature and status of fur-farming, fur-farming areas, and recommendations to beginners. Then we have a long chapter on fox farming, followed by others in which is discussed the raising of fishers, martens, minks, otters, skunks, raccoons, opossums, beavers, muskrats, rabbits, chinchillas, and Karakul sheep. Useful hints also are presented in closing chapters on transporting live animals, pelting, marketing pelts, hygiene in fur-farming, and legal considerations. The reviewer believes that this book, as well as others of the Rural Science Series in which this one appears, could have been greatly improved by the addition of a bibliography, even though incomplete.

Both author and publisher are to be congratulated on such a well written and attractive volume, which will be indispensable to fur-farmers and of interest and value to many others.—HARTLEY H. T. JACKSON.

Bailey, Vernon. ANIMAL LIFE OF THE CARLSBAD CAVERN. Monographs of the American Society of Mammalogists, no. 3. Baltimore: The Williams & Wilkins Company. 12mo, pp. xiii + 195, frontis., 67 figs. Cloth, $3.00. 1928.

Vernon Bailey presents a brief and readable description of the general biotic features of the Carlsbad region of New Mexico, with special reference to the mammals, birds, and reptiles. He properly assumes that in order to understand the animal life of the cavern it is necessary to know the kinds of animals living around its mouth.

Following an introductory chapter on the location and general features of the cavern, there are descriptions of the life zones of the region and of the conspicuous vegetation. Then a discussion is given of the relation of the native animals and plants to the aborigines, who at times inhabited the great sheltering dome of the entrance to the cavern and buried their dead far back in the darkness. Chapters follow on the mammals, birds, and reptiles of the district, important original notes being given on distribution and habits. The final chapter deals with the sparse invertebrate fauna of the cavern itself.

Of the fifty species, more or less, of mammals known to occur in the Carlsbad region only about seventeen forms are known to enter the Carlsbad Cavern or neighboring caves. These species include primitive man, bighorn sheep, rock squirrel, cave mouse, cliff mouse, white-throated wood rat, mountain lion, bobcat, brindled weasel, long-tailed skunk, spotted skunk, black bear, raccoon, ringtailed cat, free-tailed bat, jack-rabbit bat, and house bat. Remains of five other forms of bats were found in various parts of the cavern, but no live individuals were noted there.

Nearly all of these mammals seem to penetrate only into the outlying parts of the cavern, not going much beyond the limits of diffusion of daylight. Only two species were found to be distributed all over the cave. The cave mouse, *Peromyscus leucopus tornillo*, was found even to the farthest limits of the cavern, living for its whole lifetime and breeding in perpetual darkness. Its main food supply is the cave crickets (*Ceutophilus*), which also are everywhere abundant. The ring-tailed cat, *Bassariscus*, is doubtless not so much adjusted to a cavern life, but it also ranges throughout the whole extent of the chambers.

The most important bat in the cavern is the free-tailed bat, *Tadarida mexicana*. The cavern is used by these bats chiefly as a wintering place, though some occur throughout the year. Bailey estimates that hundreds of thousands or perhaps millions resort to the outer chambers for hibernation. The deposit of their guano removed for fertilizer before the cavern became a national monument amounted to over 100,000 tons.

The book is provided with a number of excellent illustrations, mostly photographs. The editing and printing maintains the high standard set by the previous monographs of the series. The reviewer confesses an objection to the abbreviated and colloquial "horntoad" employed instead of the more usual "horned toad," but this is a minor defect. For anyone interested in the natural history of southern New Mexico or western Texas the work is indispensable. While written in a style understandable by the tourist, the technical zoologist also will find much information of high value.—Lee R. Dice.

Hall, E. Raymond. The Deer of California. California Fish and Game, vol. 13, no. 4, pp. 233–259. October, 1927.

Considerable discussion has arisen over this recent paper which purports to set forth the characters, range, breeding habits and food of deer *in California*. However, we are informed (p. 245) with regard to the mule deer, which is perhaps the most important species of deer in California, that: "the following remarks on the life history of the mule deer are, unless otherwise stated, based on experience with the mule deer in Arizona where *large numbers of deer* were present and where *food was scarce*."

The undersigned sees no good reason why information pertaining confessedly to abnormal conditions on the Kaibab Plateau of Arizona should be captioned as representative of conditions in California. In working with museum specimens of mammals, no qualified investigator would think of labeling such Arizona material as Californian and great care should also be exercised in the use of data regarding such variable details of life history as, for instance, breeding habits.

Mr. Hall should receive sympathy rather than censure for numerous unauthorized editorial and other changes in his paper including such obvious mistakes as the transposing of figs. 52 and 53. In justice to all concerned it should be explained that this paper was not a contribution from the Museum of Vertebrate Zoology as seems to have been inferred by some readers.—JOSEPH DIXON.

Moseley, Edwin Lincoln. OUR WILD ANIMALS. New York and London: D. Appleton and Company. 8vo, pp. x + 310, frontispiece and many text illus. Cloth, $1.75. January, 1928.

This is in reality another edition of Mr. Moseley's book of the same title previously listed in the JOURNAL OF MAMMALOGY (vol. 8, no. 4, p. 322, November, 1927). Whereas the first edition was intended primarily as a text book for nature classes, the present edition is suitable for library purposes and is a much more attractive volume printed on a heavier paper that brings out the illustrations more clearly, and has a more artistic binding. It is the most accurate, readable, and entertaining popular and reasonable-priced book on the common wild mammals of eastern North America that has appeared in many years. Accidents will happen, however, and it is unfortunate that on page 31 a halftone of the western golden-mantled ground squirrel (*Callospermophilus*) has crept in for the common eastern chipmunk (*Tamias*). This is mentioned here not as a criticism, but as a correction. With this one exception, the illustrations are well selected and of high quality. Every nature-lover will need this book in his library.—HARTLEY H. T. JACKSON.

Weigelt, Johannes. REZENTE WIRBELTIERLEICHEN UND IHRE PALÄOBIOLOGISCHE BEDEUTUNG. Leipzig: Published by Max Weg. 8vo, pp. xvi + 227, plates 37, figures 28. Paper, 26 Gold Marks. December, 1927.

An extremely interesting book recently published by Prof. Johannes Weigelt of Halle a. S. dealing with natural agencies which account for the accumulation, disintegration, and disposal of carcasses of recent vertebrates, sets forth the writer's views on the palaeobiological significance of these factors in the interpretation of fossil remains. He expresses the hope that this work will prove of interest not only to students of geology and palaeontology, but also to those interested in biology, climatology, and geography.

The various agencies that combine to cause the disintegration of a dead animal, such as tissue decomposition, sarcophagous larvae and necrophagous insects, and varying climatic conditions are discussed in considerable detail. It is pointed out that death results not only from senility, but also from the extrusion of lava and other volcanic products, natural lethal gases, grass, prairie, and forest fires, floods, miring in mud, drifting wind-blown sands, entanglement in pools of crude oil and asphalt, contaminated drinking water, gastric

disturbances, deficiency of salt, desiccation, overcrowding during periods of drought, killing frosts, continued abnormal cold spells, and accumulation of ice, as well as from predatory animals, including man.

Another chapter deals with the occurrence of land vertebrates in marine formations, the passive position of carcasses immersed in water, the disarrangement of skeletons, the separation of the lower jaws from the skull in water-borne carcasses, rib positions, the mutilation of a carcass by carrion feeders, partial burial, the possible effects of erosion in small areas of alluvium, and the desiccation of a carcass.

This book contains a very interesting account of Professor Weigelt's trip along the Gulf Coast of North America together with observations made at Smithers Lake, Fort Bend County, Texas, on the accumulation of carcasses of various kinds of vertebrates, chiefly fish, turtles, and alligators. He discusses the climatology of the region, the topography of the lake, and the wholesale extermination of the vertebrate life of the lake by a killing frost. Interspersed with the subject matter of the text are numerous occurrences of undoubted carcass fields in past geologic times which are discussed in connection with conditions that are thought to have led to such concentrations. It appears to the reviewer that the sequence of the subject matter in some of the chapters is rather illogical. The book deserves the attention of zoologists and is a veritable storehouse of information on dead animals, recent and extinct. The index to the subject matter is unusually complete and the photographs are exceptionally good. The paper is of good quality and the typography is clear.—REMINGTON KELLOGG.

Wilson, Ambrose John. THE SIGN OF THE PROPHET JONAH AND ITS MODERN CONFIRMATIONS. The Princeton Theological Review, vol. 25, pp. 630–642. October, 1927.

The author writes (pp. 630, 639–640): "There are few stories in the Bible which have been subjected to more adverse criticism than that of Jonah and the 'great fish,' rightly interpreted, no doubt, to mean the greatest fish of all, the whale. . . . . If Modernism requires that Revelation shall be tested scientifically, it is obvious that the science so applied must be itself above suspicion. When such an event is recorded as a fact in serious literature as part of a sequence of historical events, it deserves to be treated seriously, not by impressionism, or sentiment, but by reasonable tests of physiological and historical experience. It is proposed in this article, to weigh the story by these two kinds of tests. . . . . To sum up. The story of Jonah occurs in Hebrew literature and tradition as an historical record. It can hardly be disputed that the tests applied to it are in fairness bound to be the most careful, accurate and dispassionate that science and history can supply. Physiological tests entirely disprove the alleged impossibility of the story. It is shown by study of the structure of the sperm whale and its habits that it is perfectly possible for a man to be swallowed alive and after an interval vomited up again, also for him to remain alive for two or three days within the whale. Historical tests show that a similar event has happened in later times in at least one case, and that it is quite possible for an authentic record to have survived over even a much longer period than 700 years."

Some of the science above suspicion on which these conclusions rest is as follows:

"The great fish in question would be the sperm whale or cachalot, the species which inhabits the southern waters where Jonah was voyaging. . . . . It will not therefore be considered exorbitant, if we postulate for Jonah a whale 60 feet long, with a mouth 20 feet in length, also 15 feet in height and 9 feet in width." The sperm whale has a large oesophagus because it "subsists for the most part on the octopus, the bodies of which, far larger than the body of a man, have been found whole in its stomach." But, once swallowed, "could a man live in a whale? The answer seems to be that he certainly could. . . . . There would be air to breathe—of a sort. This is necessary to enable the fish to float." With this supply of air a man could live until he starved. Being swallowed by a fish is not fatal to animal life, because a porcupine fish (Diodon) has been known to eat its way to freedom from the stomach of a shark. Being swallowed by a cachalot is not necessarily fatal to a man, because Sir Francis Fox relates in his Sixty-Three Years of Engineering, pp. 298–300, that, in 1891, a sailor, James Bartley, having been so swallowed, remained alive, though unconscious, for about 24 hours until found by his shipmates in cutting up the whale. He then passed two weeks as a raving lunatic, but eventually recovered his senses and resumed his duties. Bartley affirms that in the whale's stomach he lost consciousness from fear and not from lack of air; he could easily breathe but the heat was terrible. His skin where it was exposed to the gastric juice was permanently bleached to a deadly whiteness.[1]

The article is written with obvious sincerity and with an abundance of footnote references to pertinent literature. It is an interesting example of the psychoses which often accompany strong conviction; and to zoologists its perusal should bring a wholesome realization of the slight depth to which any clear understanding of nature has penetrated the popular mind.—G. S. Miller.

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[1] Reference to the Fox book shows that nothing in this narrative is known at first hand. "Two separate accounts have been given of the event—one evidently by the captain of the whaler; the other probably by one of the officers" (p. 298). These accounts are quoted from a manuscript left "by the late M. de Parville, the scientific editor of the Journal des Débats of Paris."

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TENTH ANNUAL MEETING OF THE AMERICAN SOCIETY OF MAMMALOGISTS

The tenth annual meeting of the American Society of Mammalogists was held at the United States National Museum in Washington, D. C., from April 10 to 14, 1928, with one hundred and twelve members in attendance. This was the largest meeting in the history of the society.

A feature of unusual interest was an exhibit of the work of American mammal artists, under the direction of E. R. Kalmbach and R. B. Horsfall, in the foyer of the National Museum. This exhibit was divided into a series comprising pictures of live mammals, in all mediums, listed in the catalogue as consisting of 142 separate items, and a second series of 50 technical drawings mostly of an anatomical nature. The following 30 artists were represented: Louis Agassiz Fuertes, Edward Herbert Miner, Frank Hennessey, O. J. Murie, Elizabeth Haban, Harry B. Bradford, Charles Livingston Bull, E. J. Sawyer, Harry B. Dillehunt, Ernest Thompson Seton, R. Bruce Horsfall, Walter J. Wilwerding, F. L. Jaques, Carl Rungius, Will Simmons, John T. Coolidge, Jr., Benson R. Moore, William Rowan, L. L. Pray, Mrs. Frieda L. Abernathy, James F. Didusch, John Christian Germann, Ernst Huber, Mrs. Louise Nash, Sydney Prentice, John L. Ridgway, Lindsey Morris Sterling, Louise Waller, Rudolph Weber, and Helen Ziska. The society is under obligation not only to these artists, but to many private owners of their pictures who contributed so largely to the success of the exhibit by the generous loan of their property.

Other special features of the meeting consisted of a symposium on whales, arranged with much thought by Remington Kellogg; an exhibition of fossil whales, arranged by C. W. Gilmore and J. W. Gidley; one of recent whales, by G. S. Miller, Jr.; and one of small traps and trapping, by Vernon Bailey.

PROGRAM

TUESDAY, APRIL 10

7:30 p.m.

Meeting of the Board of Directors at the Hotel Hamilton

WEDNESDAY, APRIL 11

9:15 p.m.

1. Parasites of whales. H. C. Raven.
2. Modification of the body musculature in whales. A. Brazier Howell.
3. Review of the placentation in whales. George B. Wislocki.
4. The bowhead whale in the western Arctic. R. M. Anderson.
5. Ziphioid and other whales from Commander Islands. Leonhard Stejneger.
6. Whaling, past and present, on the California coast. A. Brazier Howell.
7. South Shetland whaling notes. Waldo L. Schmitt.
8. Summary of available evidence bearing on the migration of whales. Remington Kellogg.
9. Economics of the whale fisheries. Lewis Radcliffe.

2:15 p.m.

10. The tale of the ancient whalemen. Chester S. Howland. Motion pictures.
11. Memoranda of the Beluga or white whale, its habits, utilization, and an account of the fishery in the Province of Quebec. Copley Amory.
12. Commercial utilization of whale fishery products. Howard J. Wordell.
13. Motion pictures of whales and sea-lions off the Alaskan Peninsula. Taken by W. L. Finley. Courtesy of Henry O'Malley.

8:00 p.m.

14. Across Asia's snows and deserts. William J. Morden. Motion pictures.

THURSDAY, APRIL 12

9:15 a.m.

15. Notes on the anatomy of a baby sperm whale. H. C. Raven.
16. Review of the morphology of the cetacean brain. O. R. Langworthy.
17. Random remarks on the Cetacea. J. T. Nichols (Read by H. C. Raven.)
18. Specialization of the mammalian facial musculature through aquatic adaptation, with emphasis on the whales. Ernst Huber.
19. Auto traffic as a destroyer of wild life. Albert R. Shadle.
20. The clavicle of the mole. A. D. Kistin. (Read by R. T. Hatt.)
21. Taming wild animals. Vernon Bailey.

2:15 p.m.

22. The introduction of mammals foreign to a region. E. A. Goldman.
23. The northward spread of the cottontail and gray fox in New York and New England. Francis Harper.
24. Wild ways of tame beasts. E. T. Seton.
25. Deer of Woburn Park. E. T. Seton.
26. The period of gestation in the monkey (*Macacus rhesus*), together with a description of the process of parturition from actual observation. Carl Hartman.

3:30 p.m.

Annual business meeting

7:00 p.m.

Annual dinner of the society

FRIDAY, APRIL 13

9:15 a.m.

27. The mammals of the Alamagordo region, New Mexico. Lee R. Dice.
28. Notes on the habits of the rock squirrel in southern New Mexico. Robert M. Bradley.
29. Over-population among *Microtus*. R. T. Hatt.
30. An intensive study of damage by the porcupine. Walter P. Taylor.
31. Photographic history of the early embryology of the rabbit. P. W. Gregory.
32. Breeding habits of *Evotomys*. Arthur Svihla. (Read by Lee R. Dice.)

33. Studies of humane trapping methods. W. E. Sanderson.
34. A study of two subspecies of *Peromyscus* at their line of contact. Adolph Murie.
35. The mammals of Kipling's verse. M. W. Lyon.
36. Getting public support for mammal protection. Ernest P. Walker.
37. *Microsorex hoyi* in captivity. W. E. Saunders.

2:15 p.m.

38. Revision of the Hyrachyidae. H. E. Wood, 2nd.
39. Early European rhinoceroses and their phylogeny. H. E. Wood, 2nd.
40. Progress and problems in mammalian research. W. B. Bell.
41. Some preliminary work on vision in the deer mouse. Paul A. Moody.
42. Notes on southwestern jack-rabbits. W. P. Taylor (with coöperation of C. T. Vorhies).
43. The elk situation. M. P. Skinner.
44. Remarks on pending legislation concerning elk. Horace M. Albright.
45. Life zones on Mount Roraima. G. H. H. Tate.

8:00 p.m.

Smoker at the Administration Building of the National Zoological Park

SATURDAY, APRIL 14

9:30 a.m.

Members assembled at the National Zoological Park and spent the morning viewing its collections under the guidance of William M. Mann. At *1 p.m.* they were the guests of Doctor Mann and the Washington members of the society at luncheon in the Administration Building.

At the annual dinner, at which the attendance was 95, the society entertained as its guests Senator Peter Norbeck of South Dakota, who has been active in behalf of conservational legislation, and Maj. R. Y. Stuart, assistant United States forester, who has at heart a program of forest research of broad scope and of great interest to zoologists. After these two friends of the society had responded briefly to their introduction by Doctor Stone, who presided, the latter entertained those present with comments concerning some 60 lantern slides of mammalogists, selected with a view to disreputability of costume or facial boskage.

It is believed that the smoker, because of the opportunity that it afforded for personal conversation, proved especially enjoyable to the members attending.

At the business meeting all present incumbents of office and all directors were re-elected. Resolutions were passed thanking the various individuals and institutions that had especially helped to make the meeting a success. Prof. Max Weber and Oldfield Thomas were elected to honorary membership.

During the past year the effort of the corresponding secretary to procure a large number of desirable new members did not meet with the success experienced during the two years preceding. This was because all lists of likely prospects had already been canvassed. The cost of obtaining new members in this manner in the future would prove higher than results would warrant. It seems probable that under present conditions the growth of the society membership in excess of

one thousand will be at a slow rate. An especial effort was made to add to the number of libraries and institutions subscribing to the JOURNAL, with gratifying success. A similar effort was made to increase the number of life members, with the result that this class of membership was augmented 90 per cent. The society is to be congratulated in having so many members willing to show their interest in such a substantial manner.

It was brought to the attention of the directors that the practice heretofore followed of not cancelling JOURNAL subscriptions until members have been delinquent in payment of their dues for a full year has resulted in an undesirably large number taking advantage of this fact. It was determined that, in the future, bills for dues should be mailed in October of each year, and that subscription to the JOURNAL should be cancelled if these remained unpaid the first of the following February. For the first time in the history of the society the paid mailing list of the JOURNAL passed the figure of one thousand last fall, but because of the number of members delinquent dues for 1927 the mailing list has again dropped to slightly below this figure.

A summary of the report of the corresponding secretary follows:

New members elected at the current meeting	93
Subscribers added since last meeting	26
Total of new additions to mailing list of the JOURNAL	119
Life members added since last meeting	26
Number of annual members of the society	916
Number of life members	55
Total present membership	971
Subscribers to the JOURNAL	985
Members lost by death since last meeting[1]	11
Resignations since last meeting	33
Dropped for nonpayment of 1925 dues	24
Number delinquent 1926 dues	23
Number delinquent 1927 dues	49
Addresses unknown[2]	8

An invitation by the University of Michigan was tendered the society to hold its next meeting in Ann Arbor, Michigan, and this was unanimously accepted. Lee R. Dice has been appointed chairman of the local committee on arrangements.

—A. BRAZIER HOWELL,
Corresponding Secretary.

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[1] H. B. Bailey, Gustav von Burg, H. E. Chapman, J. P. Cooper, L. A. Fuertes, C. Kerbert, Sterling Rohlfs, John Rowley, B. H. Swales, E. Trouessart, and L. E. Wyman.

[2] Cyril E. Abbott, George W. Boyd, Edward B. Butler, G. LeB. Foster, Alfred Marshall, Cardburt Nelson, F. H. E. Preene, and T. W. Weisemann.

COMMENT AND NEWS

The lack of taxonomic training and appreciation on the part of many zoological workers as evidenced in literature constantly comes to our attention. Investigational results in anatomy, embryology, ecology, or any of the biological sciences, have little, if any, true scientific worth unless the identification of the species employed is accurate. Two glaring instances of taxonomic blunders stand out in recent contributions. One of these is in a note by Olive Swezy on "The Chromosomes of the Rat" (Science, n.s., vol. 66, pp. 601–602, December 16, 1927), in which we find the ridiculous combination *"Rattus rattus norvegicus albinus."* Apparently this author does not realize that *Rattus rattus* and *Rattus norvegicus* are distinct species, so distinct, in fact, that they are currently placed in different subgenera. If the author actually had hybrids of these species, then the poor little chromosomes might well be pardoned for such misbehavior as is described. The second is in a paper by D. Kashkarov and L. Lein, entitled "The Yellow Ground Squirrel of Turkestan, Cynomys fulvus oxianus Thomas" (Ecology, vol. 8, pp. 63–72, January, 1927). In this latter paper ecologists actually attempt to discuss the systematic position of *Citellus fulvus*, and become hopelessly confused. Little wonder, because they use skulls of *Citellus columbianus* as *"Cynomys columbianus,"* and can find no generic differences between them and skulls of *"Cynomys"* [*Citellus*] *fulvus!* Yet the whole matter of the relation of *Cynomys* to Eurasian species of *Citellus* was clarified by Hollister (North Amer. Fauna, no. 40, p. 11, 1916), and the authors listed the publication in their bibliography!

A. M. Bailey, recently with the Field Museum of Natural History, has taken up the work in his new position as director of the Chicago Academy of Sciences, Lincoln Park, Chicago.

Dr. A. K. Fisher, chairman of the society's committee on economic mammalogy, has been relieved of the administrative duties of economic investigations in the U. S. Biological Survey that he may devote his entire time to research for the bureau. His studies will be primarily upon the economic status of hawks and owls. Stanley P. Young, a graduate of the University of Oregon, who took postgraduate work at the University of Michigan, and who has been with the Biological Survey for eleven years, succeeds Doctor Fisher as head of the division of economic investigations, in charge of rodent and predatory-animal control operations.

It would appear that mammalogy is gaining publication momentum, now that the initiative force of the JOURNAL OF MAMMALOGY has been set loose. Our first issue was in November, 1919. On January 18, 1926, as previously noted in this JOURNAL, the Deutsche Gesellschaft für Säugetierkunde was organized in Berlin. The initial number of their magazine, ZEITSCHRIFT FÜR SÄUGETIERKUNDE, was published August 31, 1926. We now have before us another commendable effort,

this time from our French colleagues. It is entitled REVUE FRANÇAISE DE MAMMALOGIE. The first number, marked Série I.—1re Année.—No. 1, dated December 7, 1927, but received at the U. S. National Museum library March 9, 1928, contains 46 pages and 6 plates, divided among three major articles and three short notes. The French mammal journal was instituted by the Société Ornithologique de France, which saw need for expansion, and decided to include the study of mammals in the sphere of its activity and to take the name Société Ornithologique et Mammalogique de France. The reorganized society, not wishing to alter the long established character of its old publication, REVUE FRANÇAISE D'ORNITHOLOGIE, decided to publish the REVUE FRANÇAISE DE MAMMALOGIE as a separate serial.

H. E. Anthony, curator of mammals in the American Museum of Natural History, left New York on April 23, 1928, for several weeks field work in Siberia.

Harry Balch Bailey, a charter member of the American Society of Mammalogists, died of double pneumonia at Buxton Hospital, Newport News, Virginia, February 10, 1928. Mr. Bailey was born in Boston, Massachusetts, February 27, 1853, the second son of Ellen M. and Joseph C. Bailey. He graduated from Boston High School at the age of fifteen, and shortly afterwards entered the wholesale dry goods business. He continued this occupation only until about 1872, when he became connected with a shipping firm in Boston. It was during this period that he developed much interest in ornithology. He married Lillie Adams Taylor of Brookline, Massachusetts, May 17, 1875. That same year, he with other men around Boston founded the Nuttall Ornithological Club. Two years later he moved to New York where with two partners he engaged in the shipping business, and in 1881 associated with others in founding the Linnaean Society of New York. In 1889, he moved to Newport News, Virginia, where he resided until his death. While in Virginia he developed considerable interest in entomology and made extensive collections of insects. His mammalogical tendencies first noticeably appeared about 1908, from which time until 1916 he worked alone and in conjunction with his son Harold on the birds and mammals of Virginia. His enthusiasm for natural history remained until the last, shared only by the public library that he founded in Newport News and of which he was honorary librarian until his death.

Sterling Rohlfs, Vermejo Park, New Mexico, was killed March 27, 1928, when a sudden gust of wind caused an airplane, carrying him and two companions, to crash to the streets of Toluca, Mexico.